DATA COMMUNICATIONS CONSIDERATIONS FOR NEW ON-LINE SYSTEMS

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1 INTRODUCTION

I INTRODUCTION

A. PURPOSE AND SCOPE

- This study is part of INPUT's continuing effort to supply meaningful information to those who are responsible for planning the complex computer/communications systems which seem to be dictated by today's technological and economic environments.

- The subject of communications is especially important, as INPUT has emphasized over the years in various reports directed to both the user and vendor communities. More specifically, clients are urged to review "Network Implementation Alternatives," which was published as part of last year's user program. That report outlined the following:

  - The general subject of network architectures.

  - The economics of computer/communications networks.

  - The various implementation alternatives available.

- The purpose of this study is to put into perspective the data communications issues related to the design of on-line systems. The report attempts to address these issues in a manner which will be easily understandable by data processing management.

- The subject is especially timely due to the vigorous activities on the part of established common carriers, new suppliers of communications services, and data processing vendors in this area.

- During the preparation of this report, the Federal Communications Commission (FCC) delivered its final ruling in the Second Computer Inquiry. This major deregulatory action was taken after years of deliberation, and its full impact is still not clear. However, INPUT's preliminary analysis of this decision has been appended.

B. RESEARCH AND METHODOLOGY

- To support this study, thirty-five end users and fifteen vendors were interviewed, largely by telephone, with a few on-site interviews.

- The end-users selected are all users of large IBM or IBM-compatible computing equipment. The rationale for this selection was that such users are the most likely to have on-line systems. This assumption proved highly accurate. Of the 35 users so selected, 34 had implemented - or were in the process of implementing - some type of on-line system. The single user without this capability indicated that it was just a matter of time before it, too, would establish on-line facilities.

- In addition to the 35 users whose responses were tabulated, two additional users were interviewed separately to obtain data pertinent to specialized areas: decentralized data bases and capacity planning. These two users were not asked the complete range of questions and so are not included in the general tabulations.

- The 15 vendors interviewed included computer manufacturers, suppliers of communications hardware and software, a common carrier, value added network suppliers, and remote computing services.

- Although vendors were queried along generally similar lines, each vendor was asked a series of custom-tailored questions either in addition to, or instead of, the "standard" vendor questionnaire. The "standard" questionnaire was intentionally designed to be very broad in order to permit participation by vendors with widely differing products.

- In addition to the 15 vendors whose responses are included in various parts of this study, INPUT also interviewed an independent industry observer in Washington, D.C. to obtain insights into the FCC regulatory process.

- The profiles of the users and vendors interviewed are detailed in Appendix A.

II EXECUTIVE SUMMARY

II EXECUTIVE SUMMARY

A. CURRENT DATA COMMUNICATIONS FACILITIES

- Although never designed for data communications, the circuit-switched (dial-up) public telephone network, along with private lines available from AT&T and an increasing number of competing carriers, function very well in that role. The transmission facilities backing the network are extremely extensive, easily accessible, and, on the whole, quite reliable and inexpensive. This, along with the variety of techniques (such as statistical multiplexing) existing or being developed to permit more efficient data communications over the public telephone network, assures that the network will serve a major portion of the communications needs of on-line and distributed data processing systems for years to come.

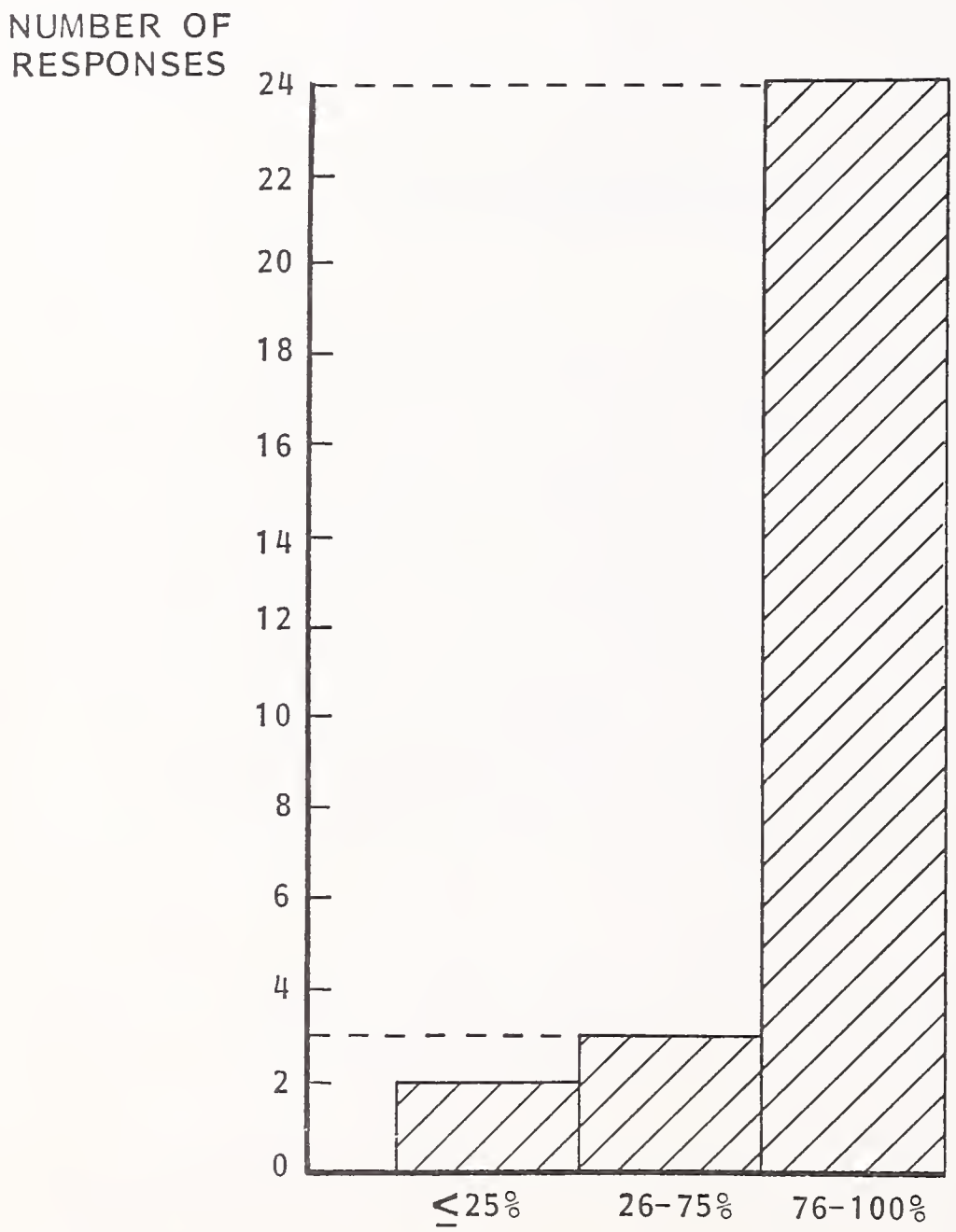
- Not surprisingly, the bulk of the data being exchanged over the traditional facilities is carried by private lines, as shown in Exhibit II-1.

- All-digital facilities, designed expressly for data communications, are being constructed by both traditional carriers (e.g., AT&T's DDS and DSDS), and by new carriers (e.g., SDX from American Satellite Corp.). These facilities hold the promise of much higher throughput at lower error rates.

- Driven by the much greater cost reductions in computing equipment relative to pure transmission facilities, value added services offering basic communica-

EXHIBIT II-1

PERCENT OF DATA MESSAGE TRAFFIC CARRIED ON PRIVATE LINES



tions packaged with additional computer-based capabilities are becoming feasible. Packet-switched public data networks (such as those offered by Telenet, Tymnet, and Graphnet) are representative of this class, with more offerings announced and planned.

- Satellite communications services, while still hampered by a host of technical and economic difficulties, are among the most promising new developments. They are already being offered commercially by such companies as Western Union, RCA, and American Satellite, with announced and planned offerings from several more, including SBS, Xerox/WUI, and Southern Pacific Communications.

B. ON-LINE SYSTEMS TECHNOLOGIES AND ISSUES

- Network architectures are generally based on the separation of communications functions into distinct layers with peer-layer, logical communication, and adjacent-layer physical communications.

- Such architectures are being offered, or have been announced, by practically all mainframe and minicomputer manufacturers. IBM's SNA is the most complete conceptually, and the best supported in terms of hardware and software products.

- The apparent conflict between computer vendors' network architectures (typified by SNA) and the Open Systems Architecture (OSA) developed by the International Standards Organization is likely to be resolved by a merger of both concepts. IBM already has an X.25 offering in Canada, Europe, and Japan, and has just introduced X.21 support in Japan. IBM support for these ISO-endorsed concepts in the U.S. is imminent.

- Job Networking, a much-less-well-known network offering from IBM, specialized for file transmission between a network of CPUs, can in fact serve the DDP needs of many organizations at far lower costs than SNA.

- Mixed networks are rapidly becoming a viable option. Beyond the simple addition of mini-based, remote job entry (RJE) terminals, new offerings from a number of minicomputer vendors permit interactive access to host-based application programs from terminals attached to the remote minicomputer. This is being accomplished with "3270-emulation" packages.

- A further step in this direction, announced by DEC for introduction this year, is full SNA compatibility, which will allow DEC minis to become SNA network nodes.

- Another clearly possible approach, though not offered as yet by any major manufacturer, is the "gateway" scheme - a logical point of interconnection between different network structures. A proposed standard for such gateways (X.75) has been introduced.

- Specialized networking systems are available. The most complete is the PIX-based scheme being offered by Paradyne.

- Remote computing services (RCS) must be regarded as viable alternatives to building an on-line or DDP network, because many of them have established extensive networks and some are even offering on-site computing hardware.

- Users as a rule appear to be unconcerned with, and ignorant of, the impact of national and international standards on their on-line system efforts. Vendors, on the other hand, rightly believe that users must understand the impact and meaning of such standards as X.25.

- In fact, because X.25 has become a sort of "fad," with many manufacturers rushing to announce "X.25 support," it is easy to overlook the fundamental fact that X.25 compatibility by itself does not assure meaningful end-to-end communications. Users who fail to grasp this may be in for nasty surprises.

C. EVOLUTIONARY TRENDS

- Two new value added services - ACS from AT&T, and XTEN from Xerox - which initially looked very promising in terms of the capabilities they planned to offer and their economics, appear to be bogged down. ACS has run into hardware and software problems and has been both withdrawn by AT&T and ruled "premature" by the FCC. XTEN has run into regulatory difficulties over the issue of spectrum allocation for its proposed microwave local loops, and is also undergoing severe organizational problems.

- Local networking is a promising new concept that can solve many of the problems addressed by on-line systems more effectively and at less cost than conventional networking. These networks rely on either base-band coax (e.g., Datapoint's ARC) or broad-band, CATV coax (Network Systems Corp.'s HYPERchannel). Ethernet, a new offering in this area, directed initially at office environments, has been announced by Xerox.

- The emergence of computerized switchboards (PABX) and fiber optics is likely to have a significant impact on data communications, although not for five or ten years.

D. REGULATORY ISSUES AND CONFLICTS

- While technology trends can be predicted relatively accurately, the legislative and regulatory tangle surrounding the communications industry and market-

place is confusing, unpredictable, and likely to remain a subject of intense controversy for many years to come.

- As this report is being prepared, the ambitious effort by Rep. Van Deerlin (D-Calif.) to rewrite the creaking Communications Act of 1934, has apparently come to a complete halt in its third try. This will return the "ball" to the FCC and the courts.

- The FCC, while clearly moving on a path leading to the encouragement of competition in areas previously reserved for common-carrier monopolies under government protection, is under heavy fire from all interested parties. In particular:

  - New, would-be common or specialized carriers feel that the FCC is not moving fast enough to permit them to enter into competition with AT&T.

  - At the same time, these new carriers are clamoring for the FCC to establish regulatory limitations on AT&T's ability to compete.

  - An especially acute conflict has been brewing over the issue of separation of regulated communications from unregulated data processing.

- The FCC's order of April 7, 1980, while apparently a major deregulatory action, will probably be tied up in the courts for years. (See Appendix D for INPUT's preliminary analysis of the order.) One thing which is clear is that there will be continuing conflict, and users of communications services should be represented in the proceedings.

E. PLANNING

- While research confirmed the fact that most on-line systems today are the result of evolution, Exhibit II-2 shows that users nevertheless believe advanced planning is one of the key factors in the success of such systems. This interesting contradiction suggests that users are not happy with the way their systems have grown.

- Users cite various vendor-related faults as the major contributing factors to unsuccessful on-line systems, as shown in Exhibit II-3.

- Users and vendors, as well as vendors among themselves, disagree sharply on the need for security in on-line systems. Users generally feel that security is, or will be, a major issue; while vendors are about equally divided, with nearly half of them tending to downgrade the significance of this issue.

- Distributed data base systems are still in the experimental stage. There are major, unresolved issues related to the implementation of such systems. More typical of today's DDP systems are "decentralized" data bases used primarily for local access at remote sites and interconnected with others primarily via low-frequency, batch-type update.

F. RECOMMENDATIONS

- The circuit-switched public telephone network, along with private line services from AT&T, will continue to play a major role in data communications for quite some time. Nevertheless, there are situations where alternate offerings may be more cost effective. Users should not overlook these alternatives:

  - Specialized offerings from AT&T (e.g., FX and CCSA).

EXHIBIT II-2

FACTORS CONTRIBUTING TO THE SUCCESS
OF ON-LINE SYSTEMS - USERS' VIEWS

FACTOR	NUMBER OF RESPONSES	NUMBER OF TIMES THIS FACTOR WAS RATED FIRST IN IMPORTANCE
THOROUGH PLANNING	19	6
ADVANCE TRAINING	15	-
USER PARTICIPATION AND COOPERATION	13	3
ACCURATE CAPACITY PLANNING AND FORECAST OF REQUIRED RESOURCES	13	-
GRADUAL IMPLEMENTATION	11	-
USE OF OFF-THE-SHELF COMPONENTS	11	6
COST EFFECTIVENESS OF SYSTEM	10	-
HAVING GOOD PEOPLE	9	9
TEAM EFFORT	9	9
HARD WORK	9	9
VENDOR SUPPORT AND COOPERATION	4	-
TOP MANAGEMENT SUPPORT	2	-
EXPERIENCE, LEARNING FROM MISTAKES	2	-
SYSTEM PROVIDES IMMEDIATE ACCESS	2	-

NUMBER OF RESPONDENTS = 35

EXHIBIT II-3

FACTORS CONTRIBUTING TO UNSUCCESSFUL ON-LINE SYSTEMS - USERS' VIEWS

FACTOR	NUMBER OF RESPONSES	NUMBER OF TIMES THIS FACTOR WAS RATED FIRST IN IMPORTANCE*
LATE DELIVERY OF EQUIPMENT AND/OR SOFTWARE	13	4
EQUIPMENT/SOFTWARE NOT PERFORMING AS PROMISED	13	5
INTERFACE PROBLEMS	7	3
OTHERS:		
POOR RESPONSE TIME	2	-
EQUIPMENT OR SOFTWARE UNRELIABLE	1	-
WENT ON-LINE BEFORE FULLY TESTED	1	-
FAULTY DESIGN CONCEPTS	1	-
INADEQUATE USER SPECIFICATIONS	1	-
LACK OF USERS' COOPERATION	1	-
LACK OF EXPERIENCE	1	-
LACK OF VENDOR SUPPORT	1	-
NO PLANNING	1	-
MISCELLANEOUS OTHERS	4	-

* IT SHOULD BE NOTED THAT 14 RESPONSES INDICATED THAT "NOTHING MAJOR WENT WRONG." THIS WAS GENERALLY THE FIRST RESPONSE TO THIS QUESTION, EVEN THOUGH IT WAS NOT FORMALLY RATED NUMBER 1

NUMBER OF RESPONDENTS = 35

- Standard and specialized services from other common carriers (e.g., Western Union).

- Offerings from specialized common carriers, including Sprint and Executnet.

- Packet-switched data networks for widely dispersed, low-volume, interactive terminals.

- Remote Computer Services (RCS) networks.

- Satellite services where wideband transmission and broadcasting capability are important.

- It is important that users become familiar with the implications of such international standards as X.25 and the nature of the SNA-versus-OSA conflict. Incomplete understanding of the meaning of X.25 and related standards can lead to exaggerated expectations of compatibility.

- Waiting for OSA to develop a fully defined networking alternative to SNA would be a mistake. The process will take many years and may never be completed.

- Although both ACS and XTEN appear to be bogged down, the capabilities that were planned for them will without doubt be reintroduced. One possible source for a new, ACS-like data network is Southern Pacific. These offerings should be carefully evaluated.

- Local networking techniques are developing rapidly and are commercially available from a number of sources. In many instances, local networks will prove easier to implement than conventional networks. This option should be considered.

- Users can influence the developments in the confusing regulatory and legislative arenas by:

  - Expending the resources necessary to understand fully the issues, the private and public bodies involved, and the mechanics of FCC rule making.

  - Joining in Political Action Committees (PACs) or in trade associations.

- Most current networks have grown haphazardly, and users are not satisfied with the results. Careful planning is obviously essential for successful implementation of new on-line systems, and the following steps should be taken to facilitate such planning:

  - Organize so that all communications (voice, data, and message) are centrally coordinated.

  - Recruit and train the personnel necessary to design and implement the integrated networks which are going to be required in the future.

III CURRENT DATA COMMUNICATIONS FACILITIES

III CURRENT DATA COMMUNICATIONS FACILITIES

A. OVERVIEW

- The key to any on-line system is the underlying communications system.

- Today, there is a wide variety of such services, and the range of available options promises to expand dramatically in the near future, as announced and planned offerings from various vendors reach the marketplace.

- Exhibit III-1 lists the major suppliers of communications services today and in the near future.

- AT&T and its Bell operating companies own the largest portion of the domestic public telephone network, which can also be viewed as a data communications network because, through an acoustic coupler, every telephone instrument can be turned into a data communications station.

- AT&T's portion of the system is interconnected with a number of independent systems, the largest one being that of GTE (16 million phones), followed by United Telecommunications (4 million phones), Continental Telephone (3 million) and Central Telephone (1 million).

- Western Union (WU) is the premier domestic "record" carrier; i.e. provider of communications between teleprinters. Western Union now operates both its

EXHIBIT III-1

MAJOR SUPPLIERS OF COMMUNICATIONS SERVICES

- TRADITIONAL LEADING COMMON CARRIERS:
  - AT&T AND ITS BELL SUBSIDIARIES
  - GTE (GENERAL TELEPHONE AND ELECTRONICS)
  - UNITED TELECOMMUNICATIONS, INC.
  - CONTINENTAL TELEPHONE CORP.
  - CENTRAL TELEPHONE AND UTILITIES
  - WESTERN UNION (TELEX AND TWX SERVICES)
- SPECIALIZED COMMON CARRIERS:
  - SPCC (SOUTHERN PACIFIC COMMUNICATIONS CO.)
  - MCI COMMUNICATIONS CORP.
  - UNITED STATES TRANSMISSION SYSTEMS (USTS) (SUBSIDIARY OF ITT)
- SATELLITE COMMUNICATIONS:
  - AT&T COMSTAR
  - RCA SATCOM
  - WESTERN UNION WESTAR
  - AMERICAN SATELLITE CORP. (ASC)
  - SATELLITE BUSINESS SYSTEMS (SBS)
  - XEROX/WESTERN UNION INTERNATIONAL (XTEN)
  - SPCC
  - HUGHES
- VALUE ADDED AND PACKET-SWITCHED PUBLIC DATA NETWORKS:
  - TYMNET
  - TELENET
  - GRAPHNET
- INTERNATIONAL RECORD CARRIERS (IRCs):
  - RCA GLOBAL COMMUNICATIONS
  - ITT WORLD COMMUNICATIONS
  - WESTERN UNION INTERNATIONAL
  - TRT TELECOMMUNICATIONS
  - FTC COMMUNICATIONS

original, baudot-code-oriented Telex system, and the ASCII-oriented TWX system, originated by AT&T's subsidiary, Teletype Corp., and since sold to Western Union. WU has established a computerized network, based on WU's own transmission facilities as well as leased facilities from AT&T, to permit cross-communications between these two incompatible record systems. WU also offers private line services similar to AT&T's.

- Following a landmark FCC decision in 1971, a number of "specialized common carriers" entered the market of point-to-point, private, interstate communications links. They include:

  - Southern Pacific Communications Co. (SPCC), a subsidiary of Southern Pacific transportation (railroad) company. SPCC has an extensive microwave network of its own, which also includes the facilities originally established by Datran, an early specialized common carrier that went bankrupt and was sold to SPCC.

  - MCI Communications Corp., which also has a microwave transmission system.

  - United States Transmission Systems (USTS), a subsidiary of ITT.

- Satellite communications have become a commercial reality, with the following participants:

  - Western Union with its own Westar satellites.

  - RCA with its Satcom satellites (of which perhaps the best known is the Satcom III, "the one that got away" - it was lost in space without trace).

  - American Satellite Corp., a subsidiary of Fairchild that leases satellite channels from WU and resells them in various formats, especially in an all-digital service dubbed SDX.

- AT&T has its own satellites (Comstar series) but is prevented by FCC rulings from using them in the private line offerings. They are used to augment the switched network instead.

- Satellite Business Systems, a venture owned jointly by Comsat, IBM, and Aetna, plans to launch its first satellite in 1980, offering a wide variety of voice, data, and image transmission services.

- Xerox has filed with the FCC for a satellite-based communications service called XTEN; the FCC as yet has not ruled on the filing. Initially a separate Xerox activity centered in Los Angeles, XTEN is undergoing an organizational upheaval as its charter is being moved to New York under Western Union International (WUI) - the international arm of WU that Xerox purchased in late 1979.

- Southern Pacific currently leases satellite channels from RCA and is planning to launch its own satellites within the next two years.

- Hughes, a major satellite builder, has also filed with the FCC for permission to launch its own communications satellites.

• Value added and packet-switched public data network services are becoming more viable. The three leading VANs are:

  - Tymnet, a subsidiary of Tymshare (a remote computing service firm).

  - Telenet, now a subsidiary of GTE.

  - Graphnet, an offering of Graphic Scanning Corp. customized to facsimile transmission. However, Graphnet has also received FCC permission to offer record services in competition with Western Union.

• In 1978, AT&T filed with the FCC an ambitious value added, packet-switched offering dubbed ACS - Advanced Communications Service. The service is

facing regulatory and judiciary hurdles, but the issue is currently moot because AT&T has withdrawn its filing due to what it describes as "software problems." Sources close to the problem say that the real issue is that the computers initially selected to act as switching nodes (DEC's 11/34 and 11/70) have proven too underpowered for the task, and the switch to the more powerful VAX 11/780 is not only causing a software problem because the VAX is not fully compatible with the PDP-11's, but also places in question the economics of the service.

- Related to the issue of data communications are the international record carriers (IRCs), which traditionally maintained teleprinter services between the U.S. and foreign countries. The relations between IRCs and domestic carriers (not only record carriers) are becoming fuzzy due to FCC rulings that permit more competition from IRCs in the domestic market on the one hand, and on the other, more international record activities by U.S. domestic carriers of all sorts. The issue is further complicated by various schemes now employed by a number of U.S. firms to offer international record and data services, bypassing the IRCs. The major IRCs today are:

  - RCA Global Communications (Globcom).
  - ITT World Communications (Worldcom).
  - Western Union International (now a Xerox subsidiary) with International Telex.
  - Several others, including TRT Telecommunications and FTC Communications.

- The remainder of this chapter is dedicated to coverage of the following topics:

  - The traditional and contemporary data communications services.
  - The newer all-digital services.

- Packet-switching public networks.

- Satellite communications services.

B. TRADITIONAL AND CONTEMPORARY DATA COMMUNICATIONS SERVICES

- AT&T, via its wholly-owned (or majority-owned) Bell subsidiaries, with 100 million installed telephones, has 82% of all local telephone service in the U.S.

- Every one of those telephones can be turned into a data communications device with the addition of a simple, inexpensive (about $100) acoustic coupler, which is a special form of a modem (modulator-demodulator), a device for converting between digital data and the analog signals suitable for transmission over the traditional telephone network.

- In this sense, the circuit-switched public telephone network in the U.S. may be viewed as one huge data communications network, with access to and from over 120 million "stations" or phone instruments. This network includes not only AT&T facilities, but also those of other common carriers (such as GTE), as shown in Exhibit III-1.

- Fully-electronic modems, from Western Electric and a large number of independent PCMs, can also be attached to the circuit-switched public telephone network via a phone-company-supplied Data Access Arrangement. Such modems can operate at much higher speeds than acoustic couplers, which are typically limited to 150-300 baud (approximately 20-40 characters/sec).

- The advantages of using the public telephone network as a means for supporting an on-line data system are fairly obvious:

  - The network exists and reaches practically every locality in the U.S., with direct dialing to Canada as well.

- Access to the network is relatively straightforward. A modem or an acoustic coupler will do.

- At the host computer end, equipment is available to permit computer-controlled dialing ("Auto-Call" units), automatic answering of incoming calls ("Auto-Answer"), and automatic allocation of a number of incoming calls to lines on a first-come, first-served basis ("Rotary").

- The disadvantages are:

  - Communication speeds are generally limited to 1200-2400 baud, suitable for interactive terminals but too slow for remote batch or buffered CRT terminals.

  - The network is expensive to use, especially for interactive terminals with long connect times and small amounts of data transmitted, because charges are based primarily on connect time (modified by the distance covered and the time of day at the point of origin of the call).

  - The dialing required each time in order to establish connection is a nuisance to the terminal user and a time-waster for computer-originated calls.

- Two popular techniques to alleviate the speed and cost disadvantages are multiplexing and concentration. Although often used as synonymous terms, there is a basic difference:

  - In multiplexing, the terminals dial a local number which connects them with a scanning device (multiplexer). With a time division multiplexer (TDM), each terminal is given a particular time slot in the scanning order. A leased line (typically) connects the remote multiplexer with the host computer, either via the intelligent front-end processor (FEP), or via a demultiplexer, which breaks out the characters from each remote terminal. The effect is that the host "sees" multiple, low-speed lines going to the remote terminals.

- With a concentrator, terminals also dial a local number which connects them to an intelligent processor with buffer memory; a complete message from a terminal is accumulated in the concentrator's buffer memory before being shipped to the host FEP at full line speed. The host "sees" a single high-speed line carrying interleaved messages from multiple terminals.

- The difference is that with unintelligent multiplexing, the leased line speed must equal the combined speeds of all terminals that can possibly be active at any one time. With concentration, line speed can be traded off for more buffering at the remote concentrator, thus avoiding the cost of a line speed which is achieved only for brief peak periods.

- Multiplexers cost approximately $2,000-6,000, while concentrators are generally much more expensive.

- Multiplexers and concentrators are available from a wide range of independents, but they can also be leased from AT&T (Datrex service) or from Western Union (Datacom service).

- In the last few years, moderately-priced Intelligent Time Division Multiplexers (ITDM) have appeared, which combine pure multiplexing with concentrator features.

- Another solution to the cost problem of the switched network is WATS (Wide Area Telephone Service). This scheme, offered by AT&T, allows essentially unlimited calls (up to 240 hours/month) for a fixed monthly fee (typically $1,700). There are many factors which determine the actual cost, but essentially, when your monthly phone bill reaches $1,500 or so, WATS may be an attractive solution. Both inbound ("800 number") and outgoing WATS lines are available, with the options of limited geographical coverage or nationwide coverage.

- Nevertheless, as Exhibit III-2 indicates, the majority of data traffic is carried not by the switched network (so called "dial-up"), but by private lines.

- Private lines can be privately constructed and owned (e.g., within an organization's geographical compound, by using microwave or infra-red, line-of-sight equipment) but by and large, "private" lines are actually non-switched arrangements leased from the local phone company.

- Charges for private lines are set by the local phone company (under control of the state's PUC) if the line is within the state, or by AT&T or other carrier (under FCC control) for interstate lines.

- Private lines are now also widely available from Western Union and from specialized common carriers such as SPCC and MCI.

- Private lines have two main advantages:

  - Much greater speed can be supported (19.2, 50, 230.4 Kilobaud and above), although voice-grade lines are still the most popular, as shown in Exhibit III-3, and can carry up to 9600 baud with special "conditioning" of the line.

  - No dialing is required - connection is continuously maintained.

- Concentration or multiplexing can be used as described above for increasing the utilization of leased lines.

- Another technique available on leased lines is "multidropping", a scheme by which several terminals can physically attach to the same leased line at the remote location.

  - Multidropped lines must be managed in some way to avoid having two or more terminals attempting to send or receive simultaneously.

EXHIBIT III-2

PERCENT OF DATA MESSAGE TRAFFIC CARRIED ON PRIVATE LINES

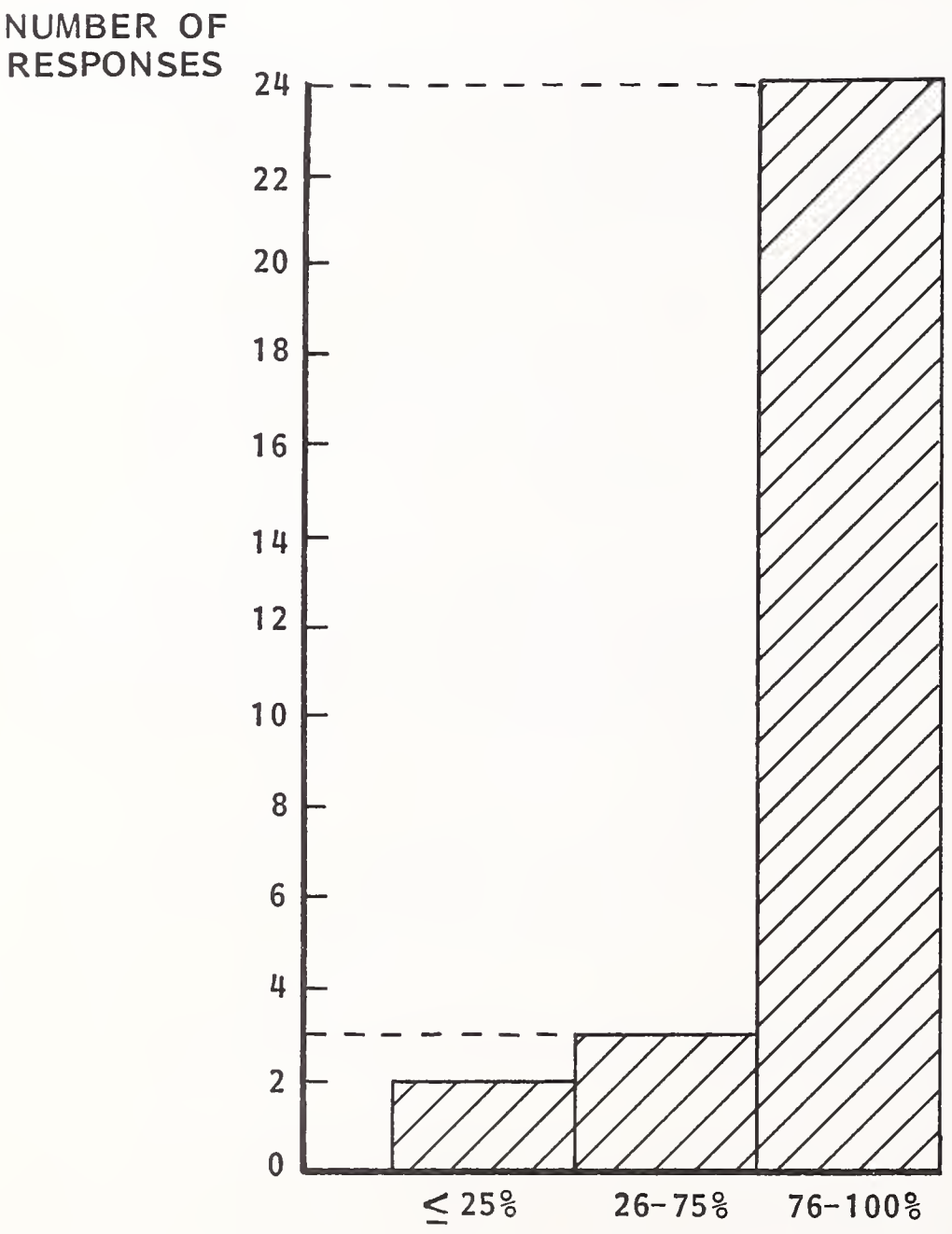


EXHIBIT III-3

DISTRIBUTION OF USAGE OF COMMUNICATIONS FACILITIES BY TYPE

FACILITY TYPE	NUMBER OF RESPONDENTS INDICATING USAGE
PRIVATE LINES	
VOICE AND BELOW	17
WIDE BAND	6
DDS OR OTHER DIGITAL	3
MULTIDROPPED	11
MULTIPLEXED	5
NO BREAKDOWN	4
SWITCHED LINES	
VOICE AND BELOW	9
DSDS	NONE
NO BREAKDOWN	2
PACKET-SWITCHED	1

NUMBER OF RESPONDENTS = 35

  - The most popular method for control of multidropped lines is "polling," a technique by which one of the stations connected to the line (typically the remote host or its FEP) is the master station, which polls the "tributary" or "secondary" stations to determine if they have anything to send.

- Still another technique available with leased lines is the FX (Foreign Exchange) service, provided by local telephone companies to allow local subscribers dial access to an intercity leased line.

- A related service called CCSA - Common Controlled Switching Arrangement - permits the establishment of private, multicity phone networks by using the telephone companies' local exchanges and intercity trunks, and AT&T's interstate lines.

- Specialized common carriers and others have a host of existing or proposed switched, intercity voice services that have some of the flavor of WATS, FX, and CCSA, specifically:

  - Execunet from MCI (existing).

  - SPRINT from SPCC (existing).

  - Metro I from Western Union (proposed).

  - City-Call from U.S. Transmission Systems (subsidiary of ITT) (proposed).

C. DIGITAL SERVICES

- The traditional telephone network is "analog" as opposed to "digital" in the sense that, though the switching mechanisms (first relays and now electronic

switching systems) have always been digital, the information transmitted through 90% of the network is still in the form of continuous tone signals.

- When digital data is to be transmitted, it is first converted to continuous tone signals by the modem.

- In a relatively recent development, portions of the network are being replaced and/or complemented by purely digital transmission facilities.

- The advantage of digital data transmission is that it is possible to sustain much higher transmission speeds at the error rates comparable to voice channels, or to sustain traditional data rates with much improved (two orders of magnitude) error immunity.

- This is due to the fact that, with repeaters placed along the line, it is possible to reshape and reconstruct the digital data stream as many times as desired, eliminating distortion due to propagation as a source of error (random noise, of course, still remains).

- Another advantage in theory is that digital data from and to computers can be transmitted on a digital network without modems. In fact, some type of interface box is required even with a digital network, although it is true that these digital interfaces are simpler and less expensive than analog modems.

- AT&T offers two versions of end user, digital transmission services;

  - Private line service, called Dataphone Digital Service (DDS).

  - Switched (dial-up) service, called Dataphone Switched Digital Service (DSDS).

- DDS is a full-duplex, point-to-point or multidrop, private line facility operating synchronously at speeds of 2,400, 4,800, 9,600, and 56,000 baud. The service is available in some 40 cities.

- DSDS is a dial-up companion to DDS. It is a later development, and is available in a limited number of cities. Speed is 56,000 baud.

- AT&T plans to increase the speeds available on DDS to 1.5M baud.

- Western Union also offers a digital Multipoint Data Service (MDS) at speeds of 1,200, 2,400 or 4,800 baud, full-duplex.

- The satellite-based service from American Satellite Corp., dubbed SDX, is also a completely digital service.

- The next few years are likely to see great expansion of digital services at the end user level.

D. PACKET SWITCHING

- Packet switching is an alternative to circuit switching as a method of sharing the resources of a common network, such as the telephone network, among multiple users.

- The first notable use of packet switching in the U.S. was in the ARPA (Advanced Research Projects Agency) network, which linked a variety of makes and models of computers around the country.

- In a circuit-switched arrangement, an actual physical circuit is established between the two subscribers via dialing; the circuit is maintained for the duration of the session, whether or not data are being transferred. Since costs are dependent in part on the connect time, this can be an expensive arrangement for interactive terminals, where "head scratching" is high relative to data transmission.

- In one packet-switching implementation, the message to be transmitted is broken up into fixed-size packets, each of which carries the address of the receiving station or destination. Each switching node in the network looks at the address in the packet and decides how to route the packet to the next node. Each packet is individually switched, possibly through many intermediate nodes, before arriving at the node to which the receiving station is connected. The packets are reassembled, if necessary, at that node and delivered to the receiving station in the order in which they were originally transmitted.

- For the duration of transmission of a message, possibly composed of many packets, a "virtual circuit" is said to exist between transmitter and receiver; in reality, the physical connection between network nodes is not switched.

- The most important advantages from the user's point of view are:

  - Pricing is independent of the distance between stations.

  - Pricing is primarily determined by volume of data transferred rather than connect time (however, there are connect time charges).

  - Depending on locations, access to the entire network is via low-cost local loops (i.e., terminal user dials a local number, assuming the network has a node available in the city).

- The major suppliers of packet-switched network services are:

  - Tymnet, a subsidiary of Tymshare.

  - Telenet, a subsidiary of GTE/Communications Network Systems.

- Although both services can be classified as packet-switched, and do share a number of characteristics (such as obtaining the physical communication facilities from the common carriers, and reselling them packaged with

additional network services - hence the name Value Added Network Services or VANS), Tymnet and Telenet do differ in numerous details of implementation, user interfaces, geographical availability, transmission speed, and rate structure. As implemented:

- Telenet uses a maximum packet size of 128 characters; in Tymnet, the packets are fixed at 64 characters.

- In Telenet, each packet is uniquely associated with the originating terminal; in Tymnet, packets are assembled from character streams generated by the various terminals connected to the node.

- In Telenet, packets are dispatched when the originating station sends an agreed-upon character (e.g., carriage return), or after an agreed-upon time has elapsed - whether or not the packet is full; in Tymnet, where packets are built with data from many terminals, packets are almost always full.

- Telenet uses adaptive routing algorithms that decide how best to route each packet; in Tymnet, a physical routing is selected when the originating terminal established the call, and the route then remains unchanged for the duration of the session.

- The two networks also differ in their interfaces:

  - In Telenet, a host computer interfaces to the network either via a Telenet-supplied interface processor (TP1000, TP2200, or TP4000 models), which performs the conversion between the X.25 packet-switched protocol and the asynchronous or synchronous protocol most convenient to the user's host software; alternately, if the host computer supports the X.25 protocol in its native software, it can tie directly into the network. The Telenet node computers perform the protocol conversion for the remote terminals.

- In Tymnet, the interface between the network and the host computer is a specialized bisync protocol, while remote terminals can be synchronous or asynchronous, with protocol conversion performed for them by the node computers. (Tymnet does support X.25 for its gateway connections to Canada's Datapac network and to Telenet).

- Telenet nodes are currently available in some 90 U.S. cities; the network is interconnenected with Datapac in Canada and with 30 other foreign countries. Tymnet's coverage is more extensive, having nodes in some 130 U.S. cities, and roughly comparable international coverage.

- Telenet supports transmission speeds of up to 56 Kbps, while Tymnet currently offers a maximum of 4,800 bps.

- The rate structures for both networks are quite complex and depend on a large number of factors; a particular point of departure is that Telenet's volume charges are based on per thousand packets, while in Tymnet, data volume is charged on a per-character basis.

- In addition to packet-switched transmission, Tymnet also offers a message-switching (electronic mail) service called OnTyme. Telenet offers only the basic packet-switched transmission, but it has more varieties of service, including PPX (Private Packet Exchange), night-time reduced charges, and a "permanent virtual circuit" service similar to a private leased line, called "Hot Line." Recently, Telenet announced plans to implement an electronic mail service.

- Although packet switching is gaining momentum both in the U.S. and abroad, it is still in its infancy. INPUT's survey of 35 users of large DP centers found only one that employed the public packet-switched network for attaching remote terminals to a host computer, as shown in Exhibit III-3.

- It is also worth recalling that when GTE acquired Telenet, that network was in dire financial straits - though GTE gives every indication of being committed to the support and expansion of Telenet.

- Although not yet available, the proposed ACS service from AT&T, and XTEN from Xerox/WUI, will probably utilize packet switching in their data communications offerings.

- A very general rule of thumb is that packet-switched networks should prove an economical alternative for attaching low-speed, interactive terminals and for electronic message exchange, but the user contemplating signing up for one of these services would be well advised to conduct a careful study to determine the costs and to compare those to the alternatives of using the public circuit-switched network, private lines with multiplexing/concentration, or even the services available via satellites.

E. SATELLITE SERVICES

- Data communications via geosynchronous-orbit satellites have, within a relatively short time, become a fully viable, commercially available alternative, with an extremely promising future.

- The main advantages that assure the future of satellite data communications are:

  - The service is inherently insensitive to distance in that all points within North America, for instance, are essentially equidistant from the satellite. This allows a distance-insensitive rate structure.

  - The capability of "broadcasting" a message to an unlimited number of simultaneous receivers is inherent in the technology.

- Very wide bandwidth is available, with low error rates.

- Potentially lower cost than terrestrial systems.

- The combination of broadcasting capability and wide bandwidth could make applications feasible which are impractical with any other contemporary technology. For example:

  - A true distributed data base with simultaneous update will be possible.

  - Massive data bases could be exchanged between nodes almost instantaneously for backup or other purposes.

- In addition, network management will be simplified by having all transmissions broadcast to all stations, with each station responding to messages directed to it.

- The major milestones in the development of satellite communications were:

  - The establishment, in 1962, of COMSAT by act of Congress, to act as the U.S. agent in the International Telecommunications Satellite Organization (Intelsat), a 90-nation cooperative for the launching and operation of international communications satellites.

  - In 1972, the FCC authorized U.S. common carriers to launch and operate domestic communications satellites for private line service on an unregulated basis. AT&T has been specifically prohibited from offering private lines via satellites, though it can use (and is using) its Comstar satellites to complement its circuit-switched public network.

- Subsequent to the FCC "open skies" decision, several organizations launched their own satellites, and others are leasing and reselling satellite channels. The satellites launched include:

- The Westar series, by Western Union, beginning in 1974.

- The Satcom series, by RCA, beginning in 1975.

- AT&T's Comstar series, beginning in 1976.

- Several other organizations plan to launch satellites, including SBS (Satellite Business Service), an organization owned equally by Comsat, IBM, and Aetna; Xerox/WUI, in connection with XTEN; and Southern Pacific Communications, in connection with a planned data network.

- Among organizations reselling satellite channels, perhaps the best known is American Satellite Corporation, which leases channels from Western Union and is offering a variety of services, including the all-digital SDX. ASC provides the oft-mentioned service that permits the Wall Street Journal to be printed at several locations simultaneously; the camera-ready copy is digitized in Princeton (NJ) and transmitted via ASC satellite service to Palo Alto (CA) and Miami for local printing. ASC is a subsidiary of Fairchild.

- The main disadvantage of satellite communications is that an expensive "earth station" is required in order to communicate with the satellite's transponders.

- The cost of earth stations puts them beyond the range of possibility for all but a very few large users. Consequently, earth stations must be shared among users.

- Current access to the earth station is primarily via the public phone network or via private lines, with microwave facilities proposed (for example, in XTEN).

- One inherent problem in satellite communications is the transmission delay. Since signals must travel approximately 44,000 miles (the satellite is approximately 22,000 miles above the earth), it takes approximately 270 milliseconds for the signal to travel one way. This causes a problem in voice

communication as well as in data communications, where the minimum delay from transmission to receipt of response is over half a second. Transmission protocols that limit the amount of data that can be transmitted without an acknowledgement (e.g., BSC where each transmission requires an explicit acknowledgement) cannot perform well on satellite links. Techniques are under development to minimize the impact of satellite link delay; for example, ASC offers a Satellite Delay Compensation Unit (SDCU) in conjunction with its SDX all-digital service.

- Users that should investigate satellite offerings include:

  - Organizations with requirements for very wide bandwidth (1.5Mbps).

  - Organizations with very high overall communications expenses for voice, data, message, and fax traffic.

  - Organizations with geographical distributions closely matching one of the satellite services' earth station locations; such organizations could effect savings even on 4.8-9.6 Kbps private line service via satellites.

F. SUMMARY OF AVAILABLE SERVICES

- Exhibit III-4 summarizes the most popular communications services currently available.

EXHIBIT III-4

CURRENT COMMUNICATIONS SERVICES - SUMMARY

SERVICE	LOW SPEED (TTY)	MEDIUM SPEED (TO 9600 BAUD)	HIGH SPEED (OVER 9600 BAUD)
SWITCHED (DIAL-UP), ANALOG	WU TWX/TELEX AT&T SERIES 1000 WU SERIES 1000 MCI, SPCC	AT&T DDD WU	AT&T DATA-PHONE 50
SWITCHED, DIGITAL	WU TWX/TELEX AT&T SERIES 1000 WU SERIES 1000 MCI, SPCC	SPCC DATA DIAL	AT&T DSDS (56KB)
PRIVATE LINE, ANALOG	WU TWX/TELEX AT&T SERIES 1000 WU SERIES 1000 MCI, SPCC	AT&T SERIES 2000 & 3000 (MPL) SPCC MCI WU MPL	AT&T SERIES 5700, 5800 (TELPAK); AT&T SERIES 8000 (WIDE BAND); WU 5000, 8800
PRIVATE LINE, DIGITAL	WU TWX/TELEX AT&T SERIES 1000 WU SERIES 1000 MCI, SPCC	AT&T DDS (2.4, 4.8, 9.6 KB)	AT&T DDS (TO 1.5 MB)
SPECIALIZED SERVICES: MULTIPLEX/ CONCEN-TRATE	AT&T DATREX WU DATACOM	WU MDS AT&T FX AT&T CCSA AT&T WATS	-

EXHIBIT III-4 (CONT.)

CURRENT COMMUNICATIONS SERVICES - SUMMARY

<table>
<tr><th>SERVICE</th><th>LOW SPEED (TTY)</th><th>MEDIUM SPEED (TO 9600 BAUD)</th><th>HIGH SPEED (OVER 9600 BAUD)</th></tr>
<tr><td>SATELLITE[2] SERVICES PRIVATE LINES</td><td>-</td><td colspan="2">AMERICAN SATELLITE SDX[1]
RCA SATCOM
SPCC[1]
WESTERN UNION WESTAR</td></tr>
<tr><td>PACKET-SWITCHED SERVICES</td><td colspan="2">GRAPHNET (TO 1200 bps)
TYMNET (TO 4800 bps)
TELENET (TO 56kbps)</td><td>-</td></tr>
<tr><td>INTERCITY SWITCHED SERVICES</td><td>-</td><td>MCI EXECUNET
SPCC SPRINT
WU METRO I[3]
USTS CITY CALL[3]</td><td>-</td></tr>
</table>

NOTES

(1) ASC AND SPCC LEASE SATELLITE TRANSPONDER CHANNELS FROM WESTERN UNION AND RCA, RESPECTIVELY.

(2) AT&T IS FORBIDDEN BY AN FCC RULING TO USE ITS COMSTAR SATELLITES FOR PRIVATE LINE OFFERINGS

(3) PROPOSED SERVICES

IV CURRENT ON-LINE SYSTEMS TECHNOLOGIES AND ISSUES

IV CURRENT ON-LINE SYSTEMS TECHNOLOGIES AND ISSUES

A. OVERVIEW

- Implementation of on-line systems today can take advantage of a wide range of standardized offerings by a wide range of vendors.

- Among the most important of these offerings are network architectures, offered by practically all mainframe and mini suppliers, though widely diverging in depth of concepts and implementation, and in breadth of products supporting or supported by the architecture.

- Specialized offerings such as Paradyne's PIXNET, as well as mixed, multi-vendor networks, are also viable options in the arsenal of tools available for building on-line systems.

- Other options include Remote Computing Services (RCS) networks and the public Value Added Network Services (VANS).

- An important issue in on-line systems which is poorly understood by users is that of standards and protocols, which are set by a variety of national and international organizations, and which to a large extent are still in the process of development.

- The remainder of this chapter elaborates on each of these points.

B. IBM'S SNA

- IBM's Systems Network Architecture (SNA), initially unveiled in September 1974, as part of a since-abandoned-term Advanced Function for Communications, is the earliest and most ambitious undertaking of its kind.

- Most other mainframe and minicomputer manufacturers have since unveiled network architectures of their own, but none of these can compare to SNA in terms of:

  - The completeness and depth of the conceptual framework.

  - The extent of hardware offerings within the network framework.

  - The extent of software products interfaced to, supporting, or implementing the network's "grand design."

- This should not be taken to mean that SNA is "perfect." There are, in fact, quite a few ambiguities and inconsistencies in the architecture. For example, while the lower levels of the transmission subsystem are fairly well-defined, the rest of the levels up to the end user are not as crisply defined and are even less clear when one examines their implementation in actual software products. It should be remembered, however, that SNA had to be imposed on an existing base of software (in fact, VTAM was close to release when it was selected as SNA's TP access method, at which time it had to be drastically redesigned). Some of the ambiguities of concepts and implementation at the higher levels are clearly due to compromises and concessions that "grand designs" usually must make to the exigencies of the real world.

- Although the SNA concept was developed by IBM's Systems Communications Division (SCD) ostensibly to serve as a company-wide standard to which all communications hardware and software offered by all divisions would have to adhere, the architecture postulated in SNA heavily favors the type of

centralized, large hosts typical of the Data Processing Division's (DPD) product line.

- Thus the initial release of SNA was concerned primarily with a single, central host supporting a network of terminals; in fact the word "network" was frequently used as a synonym for "a bunch of terminals." Even when SNA was later expanded (in 1976) to permit a multiple-host environment, that structure was still visualized as a collection of independent "domains," each domain consisting of a central host supporting a network of terminals, as in the initial concept.

- The primary concerns in the initial releases of SNA have been to:

  - Provide a scheme by which multiple application programs (APs) running in a single host could share communications lines and terminals.

  - Provide a method by which terminals could dynamically access ("log on to") any one of a number of APs running in the central host.

- It is worthwhile to remember the foregoing discussion, because it provides the needed contrast later in the discussion of alternative networking concepts from other mainframe and mini vendors, whose concerns and aims were substantially different from those of IBM.

- SNA is not easy to define concisely; in fact, it's easier to say what SNA is <u>not</u> - for instance, it is not a product (you can't buy "SNA" nor will you find "SNA" in the price book). Loosely speaking, SNA is a "grand design" for computer networking. More specifically, there are three more-or-less satisfactory ways of looking at SNA:

  - An "architecture" in the same sense that the POO (Principles of Operations manual) defines the 370 or 4300 architectures. Those architectures are visible primarily at two points: the machine-language programmer's level, and the I/O interface level. SNA is visible on

several major and minor levels, and like the POO, is fully defined at those levels but leaves internal implementation details intentionally unspecified - just as various models of the 370 and 4300 lines are varying internal implementations of the same (POO) architecture.

- A standard, not unlike those promulgated by ANSI, EIA, ISO, or CCITT; however, the SNA "standard" is more complete than all standards from the organizations just listed. Only the so-called ISO Reference Model, also called Open Systems Architecture (OSA), is as ambitious as SNA - but OSA is still a long way from being as completely defined as SNA, especially on the four upper layers (so-called layers 4 through 7). Internally within IBM, the "standard" view of SNA is probably the most accurate.

- An operating system for distributed data processing, in roughly the same sense that, for instance, say VS1 or MVS is an operating system for centralized data processing. This is, perhaps, the least satisfactory view of SNA.

- The rationale for the development of SNA, according to the more-or-less official version, is that, prior to SNA, communications problems were being tackled on an ad hoc basis, resulting in:

  - Some 200 different products relating to communications.

  - Some 35 different teleprocessing access methods.

  - Some 15 different data link controls.

- SNA was intended to put an end to this chaotic situation by postulating a single TP access method (VTAM) and a single data link control scheme (SDLC).

- Initially, SNA implied the following specific products:

- VTAM as the TP access method, in the single host CPU.

- 370X communication processor, to off-load line management details from the CPU.

- NCP as the "operating system" for the 370X.

- Terminals and cluster-controllers supporting the SDLC discipline, including 3767, 3770 line, 3600 industry terminals, and later 3790 and 3270 SDLC-compatible versions of the 3790 and 3270 families.

- The initial acceptance of SNA was very slow, because:

  - It required extended resources in terms of memory, CPU power, and 370X memory.

  - The conversion from the then-predominant BTAM to VTAM required a great effort.

  - The initial SNA features were quite limited.

- The momentum in favor of SNA is clearly picking up, because:

  - The cost of memory has come down dramatically since 1974 ($15K/MB with the initial 4300 announcement!).

  - IBM backed down from its initial, inflexible position and now permits ASCII terminals (including IBM's own, recent 3101) and the popular TCAM software within the SNA framework. These have been concessions to user preferences as well as a recognition on the part of IBM that ASCII terminals are here to stay and represent a huge market opportunity.

- Far more powerful features are now available or announced for SNA, especially:

  . Multi-host operation via the Multi-System Networking Facility (MSNF).

  . Network management and control via the NCCF and NPDA software.

  . Support of multiple inter-host links and alternate routing algorithms.

  . Improved network diagnostic capability via intelligent modems.

- IBM continues to exert pressure on users to move deeper into SNA by making more software products depend on SNA and dropping support for previous, non-SNA-dependent versions. IBM also forces users to move into the latest versions of SNA, dubbed "ACF" - Advanced Communications Function (not to be confused with the old Advanced Function for Communications) - which are all licensed Program Products, while the initial SNA components were classified as System Control Programs (SCPs) and were free.

- Many more products are now supporting SNA, including especially the 4300's and the 8100's, allowing for the first time an effective DDP network consisting entirely of DPD-supplied products.

- Support under SNA for the increasingly popular, packet-switched interface, X.25, is already available in the form of a "protocol conversion" hardware box (5973) at the terminal end, and a software PRPQ in NCP, in Canada, Europe, and Japan. In March 1980, IBM also announced support of the X.21 physical interface under SNA in Japan. In the interview with IBM for this study, IBM said that support for X.25 and X.21 in the U.S. will be offered when business considerations

justify this offering. Sources in and out of IBM indicate that the decision to offer X.21 and X.25 in the U.S. has already been reached, and its announcement is just a matter of time.

- A fundamental concept in SNA - and, indeed, in several other of the better-defined network architectures, especially the ISO Reference Model (OSA) - is that of separating the functions involved in communications between end users into several distinct layers and sublayers. The primary objectives of this separation are:

  - To make each layer self-contained so that changes to it will not require comparable changes in other layers.

  - To make the inner layers transparent to outer layers.

- The principal layers in SNA are:

  - The End User Layer (an application program in the host or a remote terminal operator).

  - Presentation Services.

  - Data Flow Control.

  - Transmission Subsystem, consisting of three sublayers:

    . Transmission Control.

    . Path Control.

    . Data Link Control.

- Although not specifically an SNA layer, the actual physical interface between the node and the transmission facility (e.g., RS232C interface) can be considered as the lowest sublayer of the Transmission Subsystem.

- The various layers, especially the three sublayers of the Transmission Subsystem, exist in every SNA node, where a node can be a host CPU, a communication controller, a cluster controller, or a terminal.

- There are well-defined protocols in SNA to permit logical communications between "peers" in the layered architecture; that is, a data link control in one node communicates logically with the DLC in an adjacent node. This is termed "node-to-node" communications. Higher levels converse with their peers in possibly several intermediate nodes before reaching the final node, to establish the "end-to-end" communications. Lower layers carry data for higher levels, but do not attempt to interpret or act on this data - only "peer layers" do this interpretation. Each layer tacks onto the data its own, unique "header" before delivering the message to a lower level; vice versa, when receiving a message, each layer strips off the header meant for its "own eyes only" by its peer layer in the remote node.

- Criticism of SNA deficiencies have largely been answered by released and announced enhancements to SNA products. Perhaps the only outstanding criticisms are:

  - The limit of seven unacknowledged frames in SDLC is a deterrant to efficient operation in satellite communication links (this is discussed in Chapter III).

  - The structure of SNA is not particularly well suited for what appears to be a trend towards the merging of data, voice, and image transmission technologies - especially when compared with the ISO OSA.

  - The structure of SNA limits the user to exclusively IBM products.

- When interviewed for this study, IBM indicated that the question of SDLC unacknowledged frame limit is under active consideration, and that the structure of SNA was in no way inadequate to support merged data/voice/image communications environments. In response to the third criticism, IBM cited its support of ASCII terminals in SNA as an indication of the lack of exclusivity. In fact, IBM claimed, SNA supports more different types of terminals from a greater variety of vendors than any other current network architecture.

C. IBM'S NJE/NJI

- SNA has taken the limelight ever since its introduction. SNA networking addresses the currently popular, interactive, on-line environment, and so most of the attention has centered on SNA. Then, too, IBM encouraged this "hoopla" around SNA because, in addition to the glamor associated with "grand designs" and interactive, on-line applications, SNA also sells equipment in the form of the additional memory - both in the CPU and in the 370X communication controller.

- For all these reasons, another networking alternative with IBM products has largely been out of the public eye. This alternative, termed NJE/NJI (Network Job Entry/Network Job Input), unlike SNA, addresses the task of connecting together a network of CPUs for the purpose of exchanging batch jobs and job output files.

- Nevertheless, the networking scheme under the NJE/NJI system is in some respects more sophisticated and more advanced than SNA.

- The capabilities of job networking represented by NJE/NJI are, in fact, sufficient to satisfy the requirements of a great many organizations who have chosen (or will choose) SNA or other on-line alternatives (in some instances, simply because they are unaware of job networking).

- In fact, IBM's own SUN network, which links together over 200 CPUs in IBM sites worldwide, relies heavily on the NJE/NJI job networking concept. The impetus for formalizing the PRPQs that supported job networking into standard Program Products came primarily from internal IBM users.

- IBM does not actively promote job networking, perhaps because it can be implemented with far less resources than SNA. However, job networking:

  - Can use BSC lines through 270X or 370X/EP, or even CTCAs. (There is no need for a big 370X with NCP, and no need for SDLC.)

  - Has its own built-in access method (RTAM) and does not require VTAM or TCAM.

- The most advanced element in IBM's job networking is an enhancement to the JES2 job entry system of MVS, called NJE - Network Job Entry. CPU nodes equipped with JES2/NJE can exchange job files, output (print/punch) files, and operator's control communications. A job may be entered on one CPU and passed along, possibly through many intermediate nodes, to a second CPU, where the job is executed; the output files generated by the job can similarly be routed via many possible intermediate nodes to still a third CPU for printing.

- Furthermore, in networks interconnected by JES2/NJE changes in the network configuration, such as the addition or deletion of CPU nodes and/or communications paths, are automatically sensed and broadcast throughout the network. This is the function of the "path manager" component of NJE; the path manager is also responsible for routing files, and can invoke alternate routing in case of path failure. These are all advanced capabilities that will only become available in SNA later in 1980-1981.

- A job network need not consist of pure JES2/NJE nodes. The RSCS/Networking program product for VM allows CPUs running under VM to participate as members of a JES2/NJE job networking system, though RSCS/Networking does not support the automatic network reconfiguration feature.

- Also capable of participation in job networking are the HASP and ASP networking PRPQs for SVS.

- All the participants in job networking other than NJE are known collectively as NJI.

- The access method used by all of these job networking components is RTAM, which employs an efficient bisync, multileaving protocol or can even use CTCA as the communications link. RTAM requires very little memory or CPU resources compared to VTAM or even TCAM.

- Although JES2/NJE is a relatively expensive program product (about $550/month), RSCS/NW is just $66/month. Users who can satisfy their DDP requirements by job networking would be well advised to take a close look at the NJE/NJI option.

D. OTHER MAINFRAME NETWORK ARCHITECTURES

- Every mainframe manufacturer today claims to have a "network architecture" of some sort, either as a released set of products or as a planned offering.

- In general, the concerns of the other-than-IBM mainframe vendors in terms of networking are quite different than those of IBM. There is a general lack of concern for the issue of "resource sharing" as defined by IBM: that is, the ability of multiple application programs to share transmission lines and terminals, and the ability of terminals to log on to different APs. The primary concerns are for multiple-CPU environments, especially when the vendor has a number of basically-incompatible CPU lines.

1. BURROUGHS

- Burroughs Network Architecture (BNA) was announced initially in 1978 and is scheduled to be released by mid-1980 for the series 6000 machines, by year-end 1980 for the small CP9500, and in 1981 for the large 7000 series. Prior to BNA, Burroughs had a less-formalized network offering, consisting of NDL (Network Definition Language) which permitted the user to specify the nature of the physical transmission facilities connected to the host; and MCS (Message Control System), a software product reminiscent of IBM's TCAM, which provided the interface to the application programs. For data link control, Burroughs has a version of ANSI's ADCCP (also ISO's HDLC). Through NDL, the user can specify the exact choice of link protocol: ADCCP, balanced point-to-point HDLC, or even SDLC. BNA, however, plans to support only BDLC on leased, switched, or packet-switched lines, with line management details transparent to the application program. The capabilities provided by BNA include:

  - Non-hierarchical, peer-to-peer network topology.

  - Access to remote files by APs coded in any high-level language supported (Fortran, Algol, Cobol, PL/1, Pascal).

  - AP-to-AP communications, whether co-resident or in remote hosts.

  - File transfers initiated by AP, by operator, or by "workflow statement" (similar to job control).

  - Support of multiple parallel links between CPU nodes.

  - Adaptive routing in case of path failure.

  - Automatic notification of network topology changes (similar to IBM's NJE).

- Support of X.25 (with X.21-bis and LAP-B initially, later the full X.21).

- Interconnect to non-BNA architectures probably via gateways.

- The main advantages of the Burroughs Network Architecture cited by Burroughs were:

  - Access to the resources in the distributed network from an AP is done in the same fashion as for local resources.

  - Peer relationship between nodes - no "host" to "slaves" relationship.

  - Transparency of network management to the APs.

2. CONTROL DATA CORPORATION

- Control Data Corporation does not claim to have a formalized network architecture, though it does have networking software and hardware products. The offering is called "Network Host Product" - a combination of Network Access Method (NAM) running in the host (somewhat like TCAM) and a communications control program (somewhat like NCP) running in a 2550 front-end communications processor. The 2550 is a microprogrammed version of the 16-bit CDC 1700 CPU, enhanced for communications. Network topology is strictly centralized on a single host, although support for multiple hosts will be announced this year. Highest line speed currently supported is 19.2 Kbps; support for 50 Kbps is in the works. An X.25 interface is scheduled for announcement this year; there are no current plans for an SNA interface.

- When interviewed for this study, CDC cited the following as the major advantages of its network offerings:

  - The comprehensive design service available from its Network Consulting Group.

- The comprehensive network construction and maintenance package available from the Engineering Services group, covering both CDC and non-CDC equipment, all the way from terminals and modems through the communications line and including the host processor.

3. HONEYWELL INFORMATION SYSTEMS

- Honeywell Information Systems' offerings encompass derivatives of several widely-divergent architectures: the original Honeywell CPUs, the 3C CPUs, the GE CPUs, and the Xerox CPUs. Perhaps for that reason HIS is particularly sensitive to the issue of compatibility at the application program level and feels that it has achieved more in this area than any other manufacturer.

- HIS network offering is dubbed "DSE" for Distributed Systems Environment. It is claimed to be an architectural umbrella for networking products, with emphasis on compatible application program interfaces for Fortran, Cobol, and data base access across the entire product line - Level 6 and Series 60.

- In the interview conducted for the purpose of this study, Honeywell identified the following as the major advantages of DSE:

  - A superior data base management system and transaction processing monitor.

  - The application-program-level compatibility across the product line.

- In Europe, Honeywell owns 47% of CII-HB, which also has to address divergent bases of CII, Bull, and Siemens machines. CII-HB designs and manufactures its own line of CPUs. In mid-1979, the French-based firm announced a network architecture called DSA (Distributed Systems Architecture) which is thought to be more comprehensive than DSE and is said to be compatible with the ISO OSA Reference Model. Packet-switched X.25 protocol is supported, as well as the conventional, circuit-switched interfaces.

4. NCR

- NCR in 1978 unveiled a network architecture with a layered structure and resource-sharing objectives not unlike SNA's, called NCR/DNA. However, unlike SNA, NCR/DNA is not dependent on a communications processor, although it can accommodate one. The applications programs are intended to be primarily Cobol, with the interface to the telecommunications access method defined by the ANSI Cobol '74 Message Control System. Support of the X.25 protocol is provided.

5. UNIVAC

- Univac has a network offering called DCA based on its communications front-end processor running under its TELCON software. The Infonet division operates a major RCS (Remote Computing Service) network, relying on microwave and satellite transmission as well as conventional facilities.

E. DEC's DNA

- DNA (Digital Network Architecture) is the architecture characterizing DEC's networking hardware and software products. The software portion of the architecture, dubbed DECnet, was released in three major phases:

  - Phase I in 1976.

  - Phase II in the spring of 1978.

  - Phase III in February 1980.

- Phase I permitted little more than task-to-task communication between CPU nodes that were directly connected via a point-to-point communications link.

- Phase II was greatly enhanced with the following additional features:

  - A task running in one node could access to all resources (tasks, disk space, files, peripherals) on another node.

  - Jobs could be submitted to a remote CPU from a terminal (including interactive terminals) attached to an adjacent CPU.

  - Down-line loading of tasks from one CPU to another.

  - Communications still needed to be point-to-point and all CPUs had to be directly interconnected to each other.

- Phase III is also a major enhancement, with the following new capabilities:

  - CPU nodes can communicate via intermediate nodes, allowing networks of as many as 100 CPUs (the direct-interconnect requirement of previous phases imposed a practical imitation of about 10 CPUs because of the communication line capacity of the controllers and the required memory to support interconnections).

  - Multipoint (multidropped) communications links are supported. This means several CPU nodes can be attached to the same physical line.

  - Adaptive routing algorithm for managing communications via intermediate nodes; optimization is based on "least cost" where "cost" or "value" is assigned by the user to each direction of transmission on each line.

  - A terminal attached to one node can access all logical resources of a remote CPU node as if it were locally attached. This capability is currently limited to like operating systems, and is called "network command terminal."

- Network management capabilities, including displaying network status, managing loop-back tests, logically removing links from the network (for testing), and automatic adjustment of routing to account for failed links.

- As evident from the above, the concerns that underlie DECnet are quite a bit different from those that motivated SNA.

- DECnet evolved to meet the needs of (typically) a laboratory environment using a variety of small PDP-11 machines; thus, although the larger DEC-10 and DEC-20 systems have DECnet software, there was never any concern with "resource sharing" in the IBM sense. On the other hand, the needs of DEC users were:

  - Ability of a very small CPU with limited or no peripherals to do program development on a larger CPU that has a full range of peripherals.

  - Ability to down-load operating systems and tasks to a remote CPU that has limited peripherals and no programmer's support.

- Although not yet available, DEC has announced that it will soon have a 3790 and an 8100 SNA emulation software which will allow DEC computers to become nodes in an SNA network.

- X.25 support, though not yet available, is promised in two phases:

  - First, a special X.25 software package that could be used instead of the three lowest levels of DNA. This would require users to implement the end-to-end protocols in their application programs.

  - Then, integration of X.25 capabilities directly into the layered structure of DNA, affording a complete end-to-end system.

- One other noteworthy change brought about by DECnet Phase III is an increase in the number of logical layers of DNA. Previously, there were three layers above the physical interface level:

  - DAP (Data Access Protocol)

  - NSP (Network Services Protocol).

  - DDCMP (Digital Data Communications Message Protocol) - a data link control.

- Phase III added a Transport Protocol (TP) layer between NSP and DDCMP and limited NSP to handling end-to-end control and session control. A Network Management layer was added between DAP and NSP; and finally, the user was recognized as a layer for the purpose of implementing the "network-command terminal" concept. The structure now looks like this:

  - User.

  - DAP.

  - Network Management.

  - NSP.

  - Transport Protocol (TP).

  - DDCMP.

- When interviewed for the purpose of this study, DEC identified the following as the major advantages of the latest phase of DECnet:

- Access to a wide variety of communications services, from low-speed local all the way to remote high-speed V.35 - better than competitors' offerings.

- Network resiliency via the adaptive routing and network maintenance software.

- Network management capabilities.

F. OTHER MINICOMPUTER NETWORK ARCHITECTURES

1. HEWLETT-PACKARD

- Hewlett-Packard has a network architecture called DSN - Distributed Systems Network. It can link together a number of HP3000 Series III "super-minis" and HP1000 small, dedicated-application minis. DSN has essentially only two layers above the physical line interface. They are:

  - Network manager and access method.

  - Data link and message control protocol.

- Communications between CPUs can be over coax, 2-wire, or 4-wire modems; however, between HP3000 and HP1000 nodes it must be coax.

- The line protocol between CPUs is point-to-point bisync. Terminals, however, can attach to a CPU via point-to-point or multipoint lines.

- Lines between CPUs are opened with an operator's command.

- The main capabilities provided by DSN are:

- Remote command processing, whereby a local terminal can execute all operating system commands (subject to authorization) on a remote processor. Some important fallouts of this facility are:

  . Ability to invoke remote program execution.

  . Ability to designate a remote terminal as the operator's console.

- Remote file access, whereby a local application program in any language can read and write remote files; the location of the file is specified in the job control statement that attaches the file. An important fallout of this capability is the ability to access and use remote peripherals.

- Remote Data Base access, whereby a local application program can access a remote IMAGE/3000 data base; the location of the desired data can be explicitly included in the program, or it can be specified externally in a local data base dictionary.

  - Program-to-program communications, possibly through intermediate nodes.

  - The accounting system is set up to keep track of local and remote access.

- When interviewed for the purpose of this study, HP identified the main advantages of DSN as:

  - Better peer-to-peer facilities than, for example, SNA.

  - Wide range of communications line optrions (coax, 2W, 4W).

  - Availability of network training and consulting services.

- It is worth noting that HP maintains one of the largest international computer networks, consisting of over 110 CPU nodes worldwide; however, the software and hardware used in this internal network, though it influenced the design of DSN, is not commercially available.

2. PRIME

- Prime has a network offering called PRIMENET which is interesting in that it is, in effect, a local network system with an X.25 interface available for remote links. The architecture has essentially four layers:

  - User services.
  - Network management.
  - Service management (HDLC when running in X.25 mode).
  - Physical interface via the Multiple Data Link Controller (MDLC) hardware, or via the PRIMENET Node Controller (PNC) for local networking.

- MDLC offers either an X.25-compatible, packet-switching interface or bisync interface for dedicated lines.

- PNC supports a ring-structure of up to 8 nodes (current software limitation) where each node in the ring can also attach to an X.25 network or to other Prime computer nodes via the MDLC.

- Remote program-to-program communication is via a software package called IPCF - Inter-Program Communications Facility; terminals attached to the X.25 network are supported at the Prime computer via the ITS software - Interactive Terminal Support.

- Remote file access is supported.

3. TANDEM

- Tandem has a network offering, but it is integrated in the operating system of Tandem's "non-stop," dual-configuration computers and is not regarded as a layered architecture. It is an extension of the inherently-redundant structure of the operating system, where the extension allows the system to recognize that a particular resource (CPU, file, peripheral) is remotely located rather than being part of the local redundant configuration.

- The networking software extension to the Guardian operating system is called Expand, and the combination is referred to as Guardian/Expand. The communications protocol is X.25-based and supports packet-switched communications, or full-duplex modem connection. Intermediate nodes are allowed, and routing tables are maintained at each CPU node. Network configuration information is broadcast through the network automatically. Network status display and recording and network diagnostics are available.

4. COMPUTER AUTOMATION

- Computer Automation also has a network offering, called "virtual network," based on the company's SyFA processors.

5. MODCOMP

- Modcomp has network software called MAXNET for its MAX II and MAX III operating systems. The networking capabilities are similar to DECnet Phase II.

6. DATA GENERAL

- Data General announced in November 1979, a plan to offer a network product family called Xodiac. It will be X.25-oriented.

G. PARADYNE's PIXNET

- Paradyne, which initially specialized in modems, now claims to be second only to IBM in its range of networking products, which includes:

  - Intelligent, microprocessor-based modems with diagnostic capabilities.
  - 3270-comparable terminals (scheduled for 3Q80 delivery).
  - PIX remote channel extender hardware.
  - PIXNET networking hardware.
  - RESPONSE standalone, DDP-oriented, 32-bit CPU.

- The intelligent modems run at 2,400 to 9,600 bps (with future extensions to 14,400 bps planned) and use the reverse-channel feature for communicating diagnostic information to a remote network tech control center.

- The 3270-like terminals will have the functions of a 327X but are not a plug-compatible replacement. They will support one additional important feature: a high-speed loop attachment, similar to the 8100 loop concept, but supported by Paradyne's own RCE (see below).

- The PIX, channel-extending concept is to make remote equipment - interactive terminals, unit record equipment, and tape drives - appear to the IBM CPU as if they were locally attached. The concept is interesting because it eliminates the need for a communications processor or even the sophisticated teleprocessing access method, like TCAM or VTAM; the remote equipment can be accessed by any software recognizing the local attachment of the device types supported remotely via PIX. The concept is implemented by having a Local Control Unit (LCU) attach directly to the byte mux channel to support a communications line to a Remote Control Unit (RCU), to which may also be attached:

- IBM or other unit record equipment (may also be attached to the LCU).

- IBM or Paradyne's 3270 interactive terminals.

- Paradyne-supplied magnetic tape drives.

- PIXNET expands the remote channel extension concept into a full-fledged network of remote peripherals by adding a Network Control Unit box which connects, via communications line, to a number of LCUs and RCUs, eliminating the direct LCU-RCU links. With the NCU, any terminal attached to any RCU can access any CPU/LCU point; even more, software in the NCU allows terminals dynamic access to multiple application programs running in the same host CPU. In this way, PIXNET implements one of the major objectives of SNA with far fewer resources - no VTAM, no 370X. Other important advantages cited for PIXNET by Paradyne were:

  - Terminals can be added to the network dynamically without requiring a sysgen at the host CPU(s).

  - PIXNET can coexist with SNA in an SNA environment.

  - PIXNET implementation is simple and requires no special communications or networking expertise.

- A new develpment in PIXNET is LCU-2, a new version which combines the function of both LCU and RCU. This not only allows 3270 loops to be attached to the LCU-2, but also allows two LCU-2s to access either of the CPUs attached.

- Paradyne's latest and most ambitious offering is RESPONSE, a 32-bit stand-alone CPU for DDP applications. Its instruction set is similar to the 370, but it does not run 370 software; rather, it has a transaction-processing-oriented operating system, which also supports COBOL. RESPONSE has IBM-compatible channels and a built-in interface called ACP, which is essentially

equivalent to the LCU-2. This gives Paradyne tremendous flexibility in building DDP networks, and the company plans to capitalize on this with what it calls "Coordinated Network Architecture" (CNA), which presumably will tie together the intelligent modems, the LCU-2s, the NCUs, and the RESPONSE systems into a coherent network.

H. MIXED NETWORKS

- For some time now, the attachment of minicomputers (typically) via communications lines to a host IBM computer (typically) has been the essence of Distributed Data Processing.

- The majority of the data transfer between the remote minis and the central host is currently in the form of remote batch entry. Practically every mini manufacturer offers software packages, along with a bisync communications interface, for the express purpose of emulating the IBM 2780 or 3780 remote batch terminal. Mini manufacturers offering such 2780/3780/HASP Workstation emulations include DEC, Prime, HP, Tandem, Computer Automation, Data General, Modcomp, SEI, and others.

- In some cases, emulation packages for the CDC 200 User Terminal, the Univac 1004 remote batch terminal, and others, are also offered.

- A more recent trend in this area has been the emulation of a 3270 cluster controller, with the objective of permitting interactive terminals attached to the remote mini to access directly application programs running on the IBM host, especially such programs as CICS, TSO, and IMS. 3270 emulation is currently offered by Prime, Computer Automation, and Tandem.

- Hewlett-Packard is planning to announce a 3270-emulation package called IML as this report is being prepared.

- Raytheon has a 3270 emulation package on its PTS1200 processors. The package is especially tailored for unloading the IBM host from its resource-consuming TSO/SPF timesharing package; and, while the Raytheon 3270-like terminals attached locally to the PTS processor can actually access TSO on the remote host, Raytheon tends to emphasize the off-line mode, under which users prepare their programs on the PTS machine in a TSO-like environment, then submit these files for compilation, assembly, and/or execution via JES, the Job Entry System of the IBM host.

- It is important to note that IBM itself is playing the 3270-emulation game in a sense. It offers, for instance, a "3270 Bisync Pass-Through" for the 4300 processors. This software does, in effect, exactly what the mini-vendors' emulation packages do: it allows 3270 terminals attached locally to a 4300 processor to carry on interactive sessions with application programs running on the remote host. The interesting part is that the Bisync Pass-Through allows a 4300 user who isn't keen on SNA to obtain on-line access to a remote host. This appears to be a concession on the part of IBM to the fact that the world hasn't quite bought the SNA concept.

- The most ambitious step in this direction has been the announced plan by DEC to offer complete SNA-compatible emulation of a 3790 or 8100. This will permit DEC to compete effectively with the 8100, and quite possibly the 4331, in the mixed network environment.

I. REMOTE COMPUTING SERVICES (RCS)

- Remote Computing Services have grown dramatically over the past few years, not only in the number of firms offering the service, but even more significantly, in the extent of their internal networking progress.

- Practically all the RCSs now offer a nationwide (and sometimes, international) network of computing centers, all interconnected by communications facilities (in some cases, advanced microwave and/or satellite links).

- This makes the RCSs a viable alternative in some cases to the establishment of a private DDP network. In fact, in some respects the RCSs can be regarded as natural competitors of the VANS (Value Added Network Services). It is no accident that the leading VANS (in terms of both revenues and nodes) is Tymnet, a subsidiary of the RCS firm Tymshare, spun off as a separate subsidiary strictly to satisfy FCC regulations.

- Among the leading RCSs with extensive networking capabilities are:

  - National CSS.

  - Tymshare.

  - Computer Sciences Corp.'s Infonet.

  - Boeing Computer Services.

  - ADP.

  - CDC's Cybernet.

  - General Electric's GENET.

- Developments of particular interest in this area are the offerings by RCS vendors of on-site processing hardware.

  - National CSS offers its IBM-compatible 3200 processor (the Two Pi/V32).

  - ADP offers the DEC 2020 processor under the name "ONSITE."

- In both cases, the processors being offered are plug compatible with, and run the same software as, the mainframes used by the RCS' computing centers. The selling tactic is simple and powerful:

  - If you are spending $10,000 a month on the remote service, for instance, you can have your own machine in-house for the same or less outlay.

  - The machine will run your present software exactly "as is."

  - If it should fail, you still have access to the vendor's network for instant backup.

J. PUBLIC VALUE ADDED NETWORK SERVICES (VANS)

- A relatively new phenomenon is that of the Value Added Network Services (VANS). They are called "value added" because they offer a combination of basic transmission facilities, which they usually obtain from the common carriers, with various services that enhance the value of the basic transmission.

- The three leading VANs now are:

  - Tymnet.

  - Telenet.

  - Graphnet.

- At least two major new VANS offerings have been announced:

  - ACS from AT&T.

- XTEN from Xerox/WUI.

- Tymnet and Telenet were discussed earlier in this report as packet-switched services.

- Graphnet is a specialized, packet-switched VANS, addressing the problem of incompatibilities between the various facsimile machines currently on the market. The added value of Graphnet is in removing these incompatibilities. Graphnet is also moving, with recent FCC approval, into domestic record (telegram) service.

- A similar offering for fax networking has recently been announced by ITT/Domestic Transmission Systems. Called FAXPAK, it's also a store-and-forward, packet-switched service.

- The proposed ACS from AT&T, which would have provided a nationwide, store-and-forward, computerized network with many value added features, such as code and format conversion between a wide variety of terminals, has run into difficulties; the company withdrew its original FCC filing, and there is some speculation that the service may never be offered in its announced form.

- The proposed XTEN service from Xerox, similar in some respects to ACS but providing higher bandwidths by relying exclusively on satellite and microwave communications, has also run into some trouble. As this report is being prepared, the original XTEN group on the West Coast is being, in effect, disbanded; the responsibility for implementing the service (pending FCC approval and assuming it is not challenged in the courts - a big assumption) has been transferred to Western Union International in New York, which late in 1979 became a Xerox subsidiary.

- There are other new and would-be entrants into the VANS marketplace, and quite a bit of activity is likely in this area in the next few years.

K. PROTOCOLS AND STANDARDS

- Everyone is in favor of standards - or are they? In fact, whether or not standards are beneficial depends very much on:

  - The degree to which the standard in question is already a de facto standard.

  - The economic interests involved.

- The most commonly cited examples for the beneficial effect of standards are the EIA RS232 interface standard and the ANSI language standards, especially FORTRAN and COBOL.

- In fact, RS232 to a large extent gave a de jure recognition of an already de facto standard established by AT&T, and the language standards have had no dramatic impact on the achievement of software portability: vendors typically offer many additional features above and beyond the standard requirements, and users rarely bother to limit themselves to the standard subset.

- Where there is no de facto standard, any attempt to standardize will cause a tremendous conflict of interest. Examples:

  - The ANSI attempt to create I/O Interface Standards is now hotly contested in the courts. (The history of that effort presents many fascinating quirks, including the fact that IBM has been consistently opposed to the effort, even though the proposed standard tries to establish IBM's own 360/370 bus/tag architecture as the standard.)

  - The conflict between the ISO efforts to create an Open Systems Architecture (OSA) that will permit equipment from various manufacturers to be tied together in a compatible network is meeting with, at best, lukewarm response from vendors who have great investments in

their own network architectures, and who are not anxious to open the door to competitive equipment.

- In general, the issue is far from clear-cut, with both pros and cons:

  - In favor of standards, it can be argued that, by allowing greater interconnect commonality, standards allow users greater selection and expand demand for all vendors' products by removing the fear of being "locked in."

  - On the other hand, standards can inhibit innovation (the main argument against the proposed I/O standard is that it will lock the industry into an essentially obsolete technology); and, if substantially different products already exist, imposing standards may render obsolete a large installed base of products (case in point: SDLC rendering the huge base of bisync gear obsolete).

- A surprisingly large number of organizations set the standards.

  - Major manufacturers establish "de facto" standards by sheer market domination (case in point: AT&T's modem interfaces).

  - The federal government.

  - National organizations such as:

    . Trade associations (EIA, IEEE, ISA).

    . ANSI - American National Standards Institute - a volunteer organization with rather loose by-laws: essentially, any individual or organization can become a member of the important ANSI X.3 (data processing) and X.4 (office equipment) standard-setting committees by simply attending two successive meetings. A recent move by CBEMA, which acts as the

administrating secretariat of ANSI's committee work, to impose participation fees in order to finance the ANSI activities will result in limiting participation to corporations only, simply because the proposed membershp fees are too high for individuals.

- International organizations such as:

  . CCITT - the International Telegraph and Telephone Consultative Committee of the International Telecommunications Union (ITU). The ITU is an agency of the United Nations.

  . ISO - International Standards Organization - an association of national standard-setting bodies from over 20 countries. Its data communications activities are concentrated in Technical Committee 97 (TC97); Subcommittee 16 of TC97 is the one responsible for the Open Systems Architecture (OSA) work.

- While vendors are practically unanimous on the user's need to study and understand some of the standards set by these organizations, as shown in Exhibit IV-1. Exhibit IV-2 shows that users appear to be equally convinced that standards don't affect their on-line systems at all.

- In fact there is little doubt that users, especially on the operational level, are not aware of the impact of existing or proposed standards. Typical comments in response to the question posed in Exhibit IV-2 were:

  - "Doesn't apply to us."

  - "We are only at the state level."

  - "We are not international."

- The rest of this section will treat some of the standards and protocols mentioned by vendors and users in Exhibits IV-1 and IV-2.

- The RS-series of standards, promulgated by the Electronic Industries Association (EIA), includes:

  - RS-232C.

  - RS-366.

  - RS-422 and -423.

  - RS-449.

- RS-232C is currently one of the most popular in the U.S. It is a standard which sets the electrical and mechanical specifications for interfacing modems (DCE - data circuit terminating equipment) with terminals or computers (DTE - data terminal equipment). RS-232C defines a 25-pin connector and the function of the signals on the various pins (not all pins have signal definitions). The standard further specifies that the distance between DTE and DCE can be as long as 50 ft. at a maximum transmission rate of 20,000bps.

- The CCITT equivalent of RS-232C is contained in two separate standards, V.24 (for electrical specifications) and V.28 (for mechanical specifications).

- RS-366 essentially gives de jure recognition to AT&T (Bell) 801 Auto Call Unit. The corresponding CCITT standard is V.25.

- CCITT also has defined additional standards that largely correspond to existing AT&T modem interfaces. They are:

  - V.21 (similar to Bell 203, to 300 baud FDX).

EXHIBIT IV-1

NATIONAL/INTERNATIONAL STANDARDS CRITICAL FOR THE USER TO UNDERSTAND IN IMPLEMENTING ON-LINE SYSTEMS

STANDARD	NUMBER OF VENDORS INDICATING IMPORTANCE
X.25	9
X.21	3
ISO/OSA	3
X.75	2
RS232	1
RS4XX	1
X.3, X.28, X.29	1
X.121	1

EXHIBIT IV-2

SPECIFIC NATIONAL/ INTERNATIONAL STANDARDS HAVING AN IMPACT ON USERS' ON-LINE SYSTEMS

STANDARD	NUMBER OF USERS INDICATING IMPACT
NONE, OR NO OPINION	30
BISYNC	1
HDLC	1
X.25	1
SNA	1
RS232	1
PACKET SWITCH	1

- V.23 (similar to Bell 202, 600/1200 baud HDX).

- V.26 (identical to Bell 201B, 2400 baud 4-wire).

- V.26-bis (similar to Bell 201C, 2400/1200 baud).

- V.27 (similar to Bell 208A, 4800 baud).

- RS-422 and -423 are new standards, intended eventually to replace RS-232. They stipulate a new 37-pin connector, and DTE/DCE distances of up to 4,000 feet. RS-422 is for transmission speeds of up to 10Mbps, while RS-423 allows a maximum of 100Kbps.

- RS-449 stipulates not only the new 37-pin connector, but also an optional, second 9-pin connector. It is intended for very high signalling rates (up to 2 Mbps) at distances of up to 200 ft. between DTE and DCE.

- The CCITT "X" series standards were designed to accomodate data networks specifically. There are quite a few "X" standards (actually they are called "recommendations", as are the "V" series, but they do in fact have the force of standards). Perhaps the more significant current "X" standards are:

  - X.20 and X.20-bis.

  - X.21 and X.21-bis.

  - X.25.

  - X.3, X.28, and X.29.

- The CCITT X.20 standard specifies the DTE/DCE interface for start/stop (asynchronous) transmission services on public data networks (PDNs). The X.20-bis (where "bis" signifies a temporary standard, issued for the purpose of compatibility only and intended for eventual replacement by the corresponding non-bis standard) defines this interface to be the same as in V.21.

- X.21 defines the DTE/DCE interface for synchronous operation on PDN. X.21 also replaces the V.25 auto-call interface. X.21-bis permits the use of the synchronous "V" series interfaces for this purpose.

- X.21 offers a number of advantages of RS-232 or the equivalent V.24/28/25.

  - Fewer interchange circuits and pins - 15 pins for X.21 versus 25-pins for RS-232.

  - Improved electrical characteristics: up to 100 Kbps at 1000 meters or up to 10 Mbps at up to 10 meters for X.21, versus 20 Kbps at 50 feet for RS-232C.

  - Enhanced capability - call progress signals, such as "number busy," "access barred," and "changed number" are provided for in the X.21 standard.

- In March 1980, IBM announced support for the X.21 interface in Japan (only) for a number of products, including the 3705 and the following terminals:

  - On switched lines: 3274, 3276.

  - On private lines: 3270, 3600, 3770, 4331, 8100.

  - Above supported by VTAM, TCAM, and NCP.

- X.25 is a comprehensive standard covering three levels of functionality:

- Physical DTE/DCE interface.

- Data Link Control Protocol.

- Packet structure (format).

- For the physical DTE/DCE interface, X.25 permits either X.21 or X.21-bis.

- For the data link control protocol, X.25 permits two options: LAP (Link Access Protocol), or LAP-B, which is designated as the 'preferred' protocol; LAP-B is a subset of the ISO-defined HDLC.

- The packet control level determines the format of the various packets used for data transfer, call setup and disconnect, and other control functions.

- The ISO-proposed OSA Reference Model stipulates X.25 as an example of the implementation of the 3 lowest levels of OSA. OSA levels 4 through 7 are as yet unspecified in terms of standards.

- The group of standards X.3, X.28, and X.29 deals with packet assembly/disassembly (PAD) to enable start/stop, asynchronous terminals to be attached to packet-switched networks. These standards contain elements which would normally be in level 6 of the Reference Model.

- It should be noted that:

  - Implementing "X.25 compatibility" implies more than just a data link control: the packet format level is a higher-level function that, in some network architectures it is up to the user's application program.

  - Furthermore, having implemented X.25 in a network does not provide the necessary end-to-end protocol, which is not explicitly specified by X.25. Unless the vendor plans to provide the end-to-end support for X.25, the user's application program will have to take care of this.

- Finally, even when a particular network architecture has implemented X.25 itself, plus some higher-level, end-to-end support protocol, there is no assurance whatever that a user on that network can communicate intelligently with another X.25 user operating on a different network architecture.

- These problems are likely to continue for many years. Due to the OSA definition, progress for the higher levels of the architecture is lagging far behind the rush to implement commercial networks. As a result, there will be completely incompatible "X.25-compatible" networks, and the users who fail to take note of this subtlety may be in for some nasty surprises.

- It is worth noting that IBM has an "X.25 compatibility" solution which is being marketed in Canada, Europe, and Japan. This solution consists of two elements:

  - A hardware protocol-converting box (5973) which attaches between the terminal and the modem at the remote end.

  - A software PRPQ for NCP in the 370X which does protocol conversion at the host's end.

- In this system, SNA messages are packetized by the protocol conversion mechanism (hardware box or PRPQ) before being delivered to the packet-switched network; the reverse procedure - assembly of packets into SNA messages - takes place when the packet-switched network delivers packets to the IBM gear.

V EVOLUTIONARY TRENDS

V EVOLUTIONARY TRENDS

A. OVERVIEW

- A number of developments are currently taking place, with great potential impact on the communications aspects of on-line systems. Among others, these are:

  - The proposed new and advanced communications networks and services represented by Satellite Business Systems, AT&T's ACS, and Xerox/WUI's XTEN.

  - The development of techniques and commercial products for implementing a variety of "local networks."

  - The emergence of fiber optics as a transmission medium.

  - The development of computerized switchboards.

- The rest of this chapter addresses these in more detail.

B. SBS, ACS, AND XTEN

- Over the past several years, a number of organizations announced plans for communications services that can have great impact on all present and future on-line systems and DDP networks. Specifically:

  - Satellite Business Systems.

  - AT&T's Advanced Communications Service.

  - Xerox's XTEN (Xerox Telecommunications Network).

1. SBS

- SBS is owned equally by IBM, Comsat, and Aetna. Its planned offering is a satellite-based, wide-band, all-digital, multipurpose communications service.

- The heart of the service is a geosynchronous satellite, expected to be launched in October, 1980, equipped with 8 transponders operating in the 12-14 GHz band. Each transponder will be capable of 41 Mbps transfer rate.

- The initial concept was to offer a wide-band service (56 Kbps minimum) exclusively to Fortune 100 organizations that could foot the bill of constructing the expensive earth stations.

- There are indications that SBS is now looking for ways to add to its potential customer base. SBS is, for instance, working with AM International on a very fast facsimile network (1 second/page rate as opposed to the current 4-5 minute/page).

- The SBS service is meant to encompass practically all forms of communications, including high-speed data transfer (to provide, for instance, a quick transfer of massive data bases as a form of disaster recovery & backup), teleconferencing (possibly with full-motion video), and voice.

2. ACS

- ACS (Advanced Communications Service), announced in July 1978, has stirred a storm of controversy (see Chapter VI). Since then, AT&T has announced a delay in the proposed October, 1979, service start, and then, in November, 1979, AT&T withdrew its FCC filing entirely. The future of the service at this point is uncertain.

- The main feature of ACS was to be the ability to interface practically any kind of terminal to any type of host computer or other terminal via a nationwide, computerized, all-digital, packet-switched network. Code, speed, and format incompatibilities were to be resolved by the network.

- ACS nodes were to contain a duplex DEC 11/70 for message switching, with duplex 11/34 front ends for data switching; further in front, locally or remotely, a microprocessor-based "Network Access Controller" intercepts the incoming access lines. (The difficulties ACS has experienced are attributed by some observers to the discovery that the computers selected proved underpowered for the job).

- Access to the nodes was to be via the AT&T Dataphone Digital Service (DDS). (Analog access would be converted to digital by a remote NAC). Access speeds were to be 2.4, 4.8, 7.2, 9.6, and 56 Kbps. Most types of terminals were to be attachable - asynchronous character, block, or polled, synchronous polled, and synchronous contention.

- Some of the services planned were:

  - Polling.

- Broadcasting.

- Authorization checking.

- Error recovery.

- Journaling.

3. XTEN

- XTEN is a proposed, satellite-based, multifunction, nationwide communications service. The service is meant for document distribution, data communication, teleconferencing, and voice. It is intended to provide terminal compatibility features similar to ACS's. Unlike ACS, the XTEN plan calls for microwave access to the local nodes, which in themselves are microwave-linked to the earth stations.

- The XTEN plan was filed with the FCC in November, 1978. About a year later, Xerox acquired Western Union International, and apparently has decided to disband the original XTEN group in Woodland Hills, CA, transferring the responsibility to WUI in New York. This transfer is causing some question about the future of the project and its schedule.

C. LOCAL NETWORKS

- Local networks can be traced back to such early arrangements as the front-end 1400 doing job entry service for a 709X; current IBM Attached Support Processor (ASP) and various multispool arrangements under MVS can also be regarded as rudimentary forms of "local networks."

- More recent developments in this area are the various schemes for interconnecting computers via a coaxial cable over relatively limited distances; hence the name "local networking." They are typically characterized by:

  - Use of a coax cable as the transmission medium.

  - Distributed network control.

  - Relatively limited distances.

  - Transmission speeds comparable or exceeding I/O channel speeds.

- The remainder of this section will discuss two commercially available local network products:

  - The ARC system from Datapoint, a base-band coax system.

  - The HYPERchannel from Network Systems Corp., a broad-band coax system.

I. ARC

- The ARC (Attached Resource Computer) system from Datapoint is a scheme for connecting a number of processors of greatly varying capabilities. The rationale that led to the development of ARC was that it would permit the firm to offer systems of greatly increased power without having to design more powerful processors.

- The heart of the ARC system is a coaxial cable transmission system, capable of supporting up to 2.5 Mbps over a total cable length of four miles. Active "HUBs," which perform signal conditioning and can be connected to up to 16 coax cables, permit topological configurations of great variety and flexibility. HUBs must be present every 2,000 ft. along the cable.

- Each of Datapoint's standard processor offerings - the 1800 CRT/diskette system, the 3800 processor, and the 6600 disk-based, standalone processor - must be equipped with a Resource Interface Module (RIM) in order to attach to the ARC coax link. The RIM can be an "outboard" box, or it can be "inboard" in the 6600 systems. The RIM is a microprocessor-driven, buffered intelligent controller that, to the processor, appears very much like a disk controller. The RIMs are responsible for the management of the ARC link. There is no central control.

- The protocol on the ARC coax is Datapoint's own; it most closely resembles a packet-switch protocol. Logically, the ARC link is a ring. Each RIM has a unique address, from 1 to 255, which determines the order in which nodes can take control of the common link. There is no central clocking. Each RIM transfers control to the next address in sequence. RIMs can be added to or deleted from the ARC link on-line. Each processor can have up to six RIMs in order to attach to more than one ARC link.

- Each processor attached to the ARC link is specialized to perform one of the following tasks:

  - File Processor, controlling one or more disks and serving all other processors' disk requests (this must be a 6600 processor).

  - Applications Processor, dedicated to executing users' tasks in COBOL, BASIC, RPG, or Datapoint's own Databus language, and to controlling the users' CRTs (this can be a 6600, 3800, or 1800 processor).

  - Communications Processor, providing communication service to typically IBM host processor with bisync 3270 emulation (this is a 6600 processor).

- There can be multiple File Processors on an ARC link. When an Applications Processor encounters a user's request to mount a disk file, low-level software in the operating system determines whether the requested disk is local; if not,

a query is broadcast to all attached processors to determine where the disk file actually resides. This appears to be a distributed data base arrangement.

- A recent addition to the ARC link is an infra-red, line-of-sight communications device. Dubbed "Light Link," it is manufactured by Datapoint; it attaches to ARC like a HUB. It is capable of distances of up to two miles. This permits connection between ARC links in separate buildings or compounds and greatly enhances the usefulness of the ARC concept.

- The advantages of the ARC system are fairly obvious:

  - It has an extendable configuration that can grow with network needs.

  - Processors can be placed where needed (within the local confines of the concept).

  - Processors can be added on-line, and failed processors do not bring down the entire system.

  - The network is entirely transparent to the user.

2. HYPERCHANNEL

- HYPERchannel, from Network Systems Corp., is a bus-structured, very-high-speed transmission system that enables interconnection of a wide variety of processors and some peripheral controllers in a local network.

- The means of interconnection is a broadband (CATV-type) coax link, capable of transmission speeds of up to 50 Mbps at distances of up to 4,000 ft. NSC has a wide range of "adapters" that attach to the coax in multidrop fashion on one side, and on the other side, to either an I/O channel of one of several CPUs, or a peripheral controller. Adapters are available from IBM, CDC, Univac, DEC, DG, Modcomp, SEL, and a number of other CPUs, as well as for the IBM 3830 disk controller and 3803 tape controller. Each adapter is based

on a proprietary, microprogrammable, ECL-implemented CPU with 4 KB memory and a CPU cycle time of 320 nsec.

- The transmission protocol is unique to NSC. It is essentially a synchronous protocol, somewhat like SDLC, with acknowledgement required for each message. Messages can be of unlimited length.

- Arbitration of bus usage is via a unique, adaptive algorithm termed "Carrier Sense Multiple Access." Each adapter is capable of sensing the presence or absence of energy on the bus. After a relatively long period of inactivity, the bus is in a pure-contention mode, where each adapter is free to take the bus at will. If two adapters take the bus simultaneously, both messages will be garbled, and the sending adapters will discover this eventually by the lack of proper response message. However, at the end of each bus activity, all adapters sense a no-energy condition and begin to count a prefixed time period, during which each adapter has a specific time slot in which it is allowed to take the bus. The effect is that, under low utilization, the bus is essentially in a pure contention mode, while during periods of high activity, the bus essentially reverts to a fixed-priority system.

- Each adapter has a unique, 8-bit address and interprets only messages addressed to it. In addition to the I/O channel and device controller adapters, there is also a "link adapter" which interfaces the HYPERchannel bus to a high-speed, microwave transmission facility, which can be used to interconnect two HYPERchannel systems at remote geographical locations. Each adapter can accomodate up to four coax links for redundancy or greater bus throughput.

- A special network maintenance console can be attached to the bus via any of the adapters. It is intended primarily for troubleshooting the adapters.

- The applications for the HYPERchannel system might be:

- Interconnect a number of dissimilar computers via their I/O channels at full I/O channel speeds.

- Permit sharing of disk and/or tape controllers by a number of CPUs.

- "Back End" storage networks.

- Allow any of several I/O channels on the same CPU to access any of a number of disk or tape controllers.

- Allow access from one or more CPUs to the high-speed link adapter.

- NSC identified the following as the major advantages of the system:

  - Provides a generalized system interconnect capability.

  - Permits high-speed communications.

  - Allows flexible placing of computing equipment without suffering the usual throughput degradation penalties.

3. OTHER LOCAL NETWORK PRODUCTS

- Two other, commercially available, local network products are worth mentioning:

  - Prime has a local, ring-structured network scheme, based on its PNC - Prime Network Controller.

  - Xerox has recently announced Ethernet, a coax-based, distributed-control, local network intended for interconnecting office equipment; the first product with Ethernet attachment capability is the 860 line of word/data processors, which is yet to be delivered.

D. EMERGING NEW TECHNOLOGIES

- A number of developments that can have an impact on on-line systems have become clearer over the past few years and are worth watching. Among them are:

  - The use of fiber optics for communications.

  - The computerized switchboard.

- Fiber optics have been used on an experimental basis to provide, for instance, local loops for telephone service.

- Fiber optical cables have the advantages of:

  - Small physical size.

  - High data rate.

  - Low error rate.

  - Relatively high security.

- Currently, fiber optical systems are still more expensive than conventional technologies, but this could change within the next few years.

- The advent of the computerized switchboard, referred to as CBX (Computerized Branch Exchange), PABX (Private Automatic Branch Exchange), EPABX (Electronic Private Automatic Branch Exchange) and similar acronyms, has made possible not only more sophisticated telephone services, but the potential of becoming a single point of switching for voice, data, and images (e.g., facsimile). The process is in its very early stages, but is clearly worth watching.

VI REGULATORY ISSUES AND CONFLICTS

VI REGULATORY ISSUES AND CONFLICTS

A. OVERVIEW

- Strong conflicts over issues relating to government regulation of the communications industry have been, and continue to be, a major feature in the development of U.S. communications services.

- These conflicts are fueled by many factors:

  - Government regulation of interstate communications services has been a way of life for seventy years now; local government regulation of intrastate services goes back even further, to 1885.

  - AT&T, its Bell operating companies, and other subsidiaries, after initially resisting regulation, have learned not only to accept it but to thrive on it. AT&T is now one of the world's largest corporations, with $45 billion revenues, 750,000 employees, $100 billion worth of assets, and about 82% of all local telephone service in the U.S.

  - Advances in technology increasingly call into question the assumption that communications services are a "natural monopoly" - the basic premise justifying regulatory protection of AT&T's business.

- Responding to public pressures, the FCC, beginning with the 1968 Carterfone decision, took a series of steps to permit varying degrees of competition in areas that were previously under government-protected, AT&T monopoly.

- Would-be competitors of AT&T argue that the sheer size of AT&T, achieved under years of government-protected monopoly, is making it impossible to compete effectively. They urge that:

  . More areas of the market be opened up to competition by deregulation.

  . AT&T be placed under various forms of restrictions to permit newcomers to compete effectively.

- The Justice Department's second major anti-trust action against AT&T was settled by the 1956 Consent Decree, under which AT&T agreed that its Bell operating subsidiaries would engage exclusively in offering regulated communications services.

- In view of the increasing competition forced on AT&T by the FCC, AT&T is responding by entering into activities that increasingly bring it into direct conflict with the Consent Decree; the FCC tends to agree with AT&T's position on this issue, while the Justice Department wants to enforce and enlarge the Decree.

- The Justice Department is currently engaged in a third major anti-trust proceeding against AT&T, seeking this time not only the divestiture of AT&T's main manufacturing arm, Western Electric, but also its Bell operating companies and its Long Lines Division.

- Far from being unanimous, various government agencies such as the Justice Department, the FCC, the NTIA unit of the Commerce Department, and several others are often in direct conflict on issues related to communications and regulation policies.

- As the demarcation lines between "communications" and "data processing" become increasingly hard to draw, vendors of data processing hardware and software are increasingly concerned that various offerings from AT&T are encroaching on their turf. Major bones of contention here are:

  . The Dataspeed 40 terminals from Teletype, an AT&T subsidiary.

  . Horizon, the computerized PABX with built-in industry applications software.

  . The proposed Advanced Communications Service (ACS) from AT&T, which combines communications and data processing.

  . The sale of Bell-developed, UNIX software by AT&T.

- There are many other parties with direct interest in these issues, including specialized common carriers, international record carriers (IRCs), value added network services (VANS), terminal manufacturers, and various users of the radio spectrum, in addition to AT&T, the government, and computer/software vendors.

- The diversity of conflicting interests is very wide and the economic stakes are enormous.

- It is, therefore, highly unlikely that any legislative, regulatory, or judicial action will be resolved in the near future in a way that will satisfy all concerned.

- The only possible prognosis is for many years of protracted conflict over:
  - The extent and nature of government regulation.
  - The type and nature of activities to be exempt from regulation.
  - The role and structure of AT&T and its subsidiaries.
  - The type and nature of firms engaged in regulated versus unregulated communications/data processing activities.
- Exhibit VI-1 indicates that end users are, by and large, unaware of the impact of regulatory issues. This is so because:
  - The issues are complex and require resources to study initially and to keep abreast of developments.
  - The activities in this area are carried out in FCC rule-making procedures and in the courts, largely out of the public eye.
- Despite this, almost all users interviewed had an opinion on the subject and, without exception, all who had an opinion were in favor of "less regulation" and "more competition," echoing what appears to be a universal mood in the country as a whole.
- It should be noted that the attempt to allow competition is resulting, in some notable cases, in increasing expenses to the end user, contrary to the general feeling that "competition is good." Cases in point:
  - In 1976, the FCC rejected the Telpak tariff, a high-speed, private line service from AT&T, on the grounds that it provided an unjustifiable discount relative to an equivalent number of low-speed lines. The FCC also objected to AT&T's refusal to permit sharing or reselling of Telpak's bandwidth. AT&T responded by proposing to eliminate the

EXHIBIT VI-1

USERS' PERCEPTIONS OF IMPACT OF GOVERNMENT REGULATIONS ON COMMUNICATIONS

EXTENT OF IMPACT	NUMBER OF RESPONSES
GREAT IMPACT	2 (6%)
SOME IMPACT	2 (6%)
NO IMPACT	29 (85%)
DON'T KNOW	1 (3%)

NUMBER OF RESPONDENTS = 34

service altogether. The universal howl of protest from Telpak users, including DOD and GSA, forced the FCC to relent temporarily. The issue is still not entirely resolved as this report is being prepared.

- In 1977, the FCC ordered AT&T to raise its proposed tariff for DDS.

- In 1979 and 1980, the FCC rejected several requests by AT&T to raise rates for interstate calls, WATS, and private line service because the FCC deemed the proposed rates too low.

- In both latter instances, the FCC rationale has been, in effect, that higher rates were required in order to permit AT&T's competitors to compete effectively. The formal argument is that the cost basis provided by AT&T did not reflect the full cost of providing the service.

- The rest of this chapter reviews the essence of the various conflicts as exhibited in:

  - Congressional legislative activity.

  - FCC regulatory activity.

  - Actions before the judiciary.

B. CONGRESSIONAL LEGISLATIVE ACTIVITY

- Interstate communications comes under FCC regulation by the provision of Title II of the Communications Act of 1934, which is still the applicable law in effect. This Act also created the FCC.

- The 1934 Act was passed to encourage the formation of a nationwide telecommunications system, based on the concept that such a system would be a "natural monopoly."

- The provisions of the 1934 Act have become increasingly anachronistic since the goal of building a nationwide telecommunications system has been fully achieved, and the assumption of "natural monopoly" is becoming increasingly questionable in the light of new technology.

- The increasing irrelevance of the law's provisions in today's environment has placed augmenting stresses on the FCC and the courts, as they attempt to reconcile the law with rapidly changing technology and market conditions.

- Beginning in 1968, the FCC has undertaken a series of moves designed to permit increasing degrees of competition in areas that were previously under a government-regulated monopoly held by AT&T and its subsidiaries. These include:

  - The Carterfone decision of 1968, which permitted the attachment of "foreign" (non-Bell) equipment to Bell communication lines.

  - The 1971 decision to allow specialized common carriers to offer interstate, point-to-point private lines in competition with AT&T's Long Lines Division.

- In 1976, in an effort to stem the FCC moves to permit the entry of new competitiors into the interstate communications services, AT&T instigated a proposed legislation which would have, in effect, prohibited such competitive entries. The bill, officially named the "Consumer Communications Reform Act of 1976" (H.R. 12323), was referred to by its many opponents as the "Bell Bill," because it was so blatantly biased in favor of AT&T. Despite AT&T's massive lobbying in favor of the bill, it failed to pass.

- In 1978, an attempt at a complete rewrite of the 1934 Act was introduced by Representative Lionel Van Deerlin (D-Calif.), chairman of the House Communications Subcommittee.

- Perhaps the main impact of the original Van Deerlin bill in the area of data/voice communications would have been the provision that prohibited cross-ownership of manufacturing facilities by providers of monopoly communications services. This would have forced AT&T to divest itself of its main manufacturing arm, Western Electric. GTE would also have been affected and would have been required to establish separate entities for manufacturing and regulated communications services.

- The divestiture of Western Electric has long been the objective of anti-trust proceedings initiated by the Justice Department, basically on the grounds that, when AT&T and its subsidiaries buy their equipment exclusively from WE, there is no way to tell what the market value of the equipment would have been under a more competitive arrangement; and the value of assets is the prime determining factor in setting regulated service rates.

- Many other organizations outside the Justice Department support the divestiture of Western Electric as a means of opening up the market for more competition.

- Many others, however, fear that with some $8 billion in revenues, an independent Western Electric would be no easier to compete with than under the current situation.

- Another provision of the initial Van Deerlin bill would have replaced both the seven-member FCC and the NTIA with two separate bodies:

  - A five-member Communications Regulatory Commission to establish rate structures and administer technical regulation.

- National Telecommunications Agency, a policy-setting body for communications.

- This would have satisfied those who feel that, as presently structured, the FCC is chartered with both encouraging the industry as well as regulating it, resulting in a "tilt" in favor of AT&T.

- The original Van Deerlin bill also covered radio, television, and cable television, generally in the direction of far less regulation.

- Two provisions in those areas caused some concern:

  - The bill included a plan to levy graduated fees for the use of the radio spectrum, especially by broadcasters. This caused concern by other users of the spectrum.

  - Deregulation of broadcasting would remove some of the incentive for allowing public service access, which is causing concern among minority groups.

- On the whole, the impact of the bill would have been to lessen regulation and encourage competition.

- The majority of vendors interviewed for this study generally supported the Van Deerlin bill.

- After prolonged hearings, deliberations, and a revised version of the bill introduced in March, 1979, the bill has now been re-introduced in a drastically revised, reduced version.

- The new bill (H.R. 6121), Van Deerlin's third attempt, nicknamed "Grandson of Rewrite," no longer asks for a breakup of the FCC. Instead, it stipulates: "Competition shall be relied upon to the maximum extent possible to determine the availability, variety, quality, and cost of telecommunications services and facilities."

- The bill would deregulate all intercity services and carriers, with the exception of "dominant carriers," defined to include only AT&T.

- Under the bill, local phone companies would be permitted to charge an "access fee" to intercity carriers.

- The bill restricts AT&T and Western Electric from engaging in activities other than basic communications.

- However, AT&T would be permitted to offer data processing services and products through fully separate subsidiaries, with accounting systems that ensure that monopoly revenues are not used to support competitive services.

- The bill would also deregulate the terminal business. (As this report was being prepared for release, the FCC deregulated all computer-based communications services including all on-line terminal equipment. This ruling was part of the "Final Decision in the Second Computer Inquiry" - see Appendix D.)

- This newest bill gave up completely on the attempt to provide a comprehensive revision of the 1934 Act in the areas of radio, television, and cable TV.

- Also abandoned was the cross-ownership provision that would have required AT&T to divest itself of Western Electric, a move which AT&T has vehemently opposed.

- Not unexpectedly, the new version of the Van Deerlin bill is being strongly opposed by various industry associations (ADAPSO, CCIA, IDCMD, and NATA) as being too soft on AT&T.

- Nevertheless, the bill in its present form was approved by the House Communications Subcommittee in February 1980, and is scheduled to come before the full House Commerce Committee in March.

- The Senate Communications Subcommittee is also considering several draft bills. There are, however, considerable partisan differences in connection with these bills, and, as a result, the passage of any kind of communications bill into law in 1980 is far from certain.

C. FCC REGULATORY ACTIVITIES

- The landmark Carterfone decision in 1968 was the first in a series of FCC moves to admit dozens of new competitors into activities that were previously strictly within AT&T's Bell System's regulated domain.

- Under the current FCC Chairman, Charles D. Ferris, who is a firm supporter of deregulation, this trend is likely to be continued and expanded.

- Phillip Verveer, who recently (July 1979) became the head of the FCC's Common Carrier Bureau, is known for his "anti-AT&T" posture and can be expected to support deregulation trends.

- Nevertheless, the majority of the new, would-be suppliers of communications services and products, as well as the established suppliers of data processing services and products, are convinced that:

  - The FCC is still "tilted" in favor of AT&T's position and is inclined to permit AT&T to enter competitive ventures.

  - The FCC is too slow in proceeding with deregulation that will permit newcomers to compete with AT&T.

- The blurring of the demarcation line between the traditionally regulated communications activities and the fiercely competitive data processing domain motivated the FCC to launch, in 1971, its first Computer Inquiry, now known as "Computer Inquiry I."

- The results of Computer Inquiry I may be summarized as follows:

  - The FCC decided it would not assert regulatory authority over data processing activities, whether or not such activities involved communications facilities, such as linking subscribers' terminals to central computers.

  - This opened the door for common carriers such as AT&T to offer data processing services, raising the objection that the monopoly of AT&T, protected by government regulation, would present an unfair competitive advantage vis-a-vis the unregulated data processing suppliers.

  - To alleviate this difficulty, the FCC adopted a policy of "maximum separation," under which common carriers were required to establish separate corporate entities for furnishing data processing services.

  - To distinguish between "data processing" and "communications" for the purposes of applying the maximum separation policy and the "forbearance" policy of declining to regulate "data processing," the FCC postulates a set of definitions of what constitutes "communications" and "data processing."

- Since the release of the FCC's final decision in Computer Inquiry I, technological and market developments showed that the matter of "communications" versus "data processing" needed a thorough re-examination.

- This re-examination, launched by the FCC in August 1976, is now known as "Computer Inquiry II."

- Specific isues on which the FCC solicited comments under Computer Inquiry II were:

  - Refinement of the definitions of "data processing" and "communications," in view of such developments as the Distributed Data Processing (DDP) networks and intelligent terminals which combine DP functions and communications facilities.

  - The question of regulated common carriers offering sophisticated terminals on a competitive basis.

- In March 1977, after the FCC decided (in November 1976) to authorize AT&T to offer the Dataspeed 40 terminals, manufactured by its Teletype subsidiary as a tariffed offering by AT&T's regulated Bell subsidiaries, Computer Inquiry II's scope was supplemented to include the issues raised by a common carrier's provision of peripheral devices which include processing capabilities.

- A major milestone in Computer Inquiry II was reached on May 17, 1979, when the FCC adopted a tentative decision. The elements of this tentative decision can be summarized as follows:

  - The FCC proposed to divide common carrier services into three categories:

    . Voice.

    . Basic non-voice.

    . Enhanced non-voice.

  - The "voice" category encompasses the traditional human-to-human oral communication; i.e., the "plain old telephone" or POT in the popular slang.

- The "basic non-voice" category encompasses pure transmission in which neither context nor form of the message is in any way changed or rearranged.

- The "enhanced non-voice" category encompasses services which employ computer processing to act on such things as the context, format, code, and protocol of the transmitted messages.

- The FCC concluded that common carriers owning transmission facilities used in interstate communications can offer "voice" and "basic non-voice" services, but not "enhanced non-voice."

- The FCC further ruled that such common carriers may offer "enhanced non-voice" services only through a separate corporate entity, which would have to purchase the necessary basic communications services from the common carriers before reselling them to the public as "enhanced" services; and that the computer facilities used by common carriers to provide "voice" and "basic non-voice" services may not be used for computer processing associated with "enhanced non-voice" services.

- The effect of this ruling is to change the previous concept of separation between "data processing" and "communications" to that of separation of an underlying basic service offered by a common carrier under regulated tariffs, and the reselling by "resale subsidiaries" of enhanced communications services which combine with processing activities.

- Resale subsidiaries can offer data processing services on an unregulated (non-tariffed) basis.

- Resale carriers are allowed to offer any sophisticated terminals for use on the customer premises (so-called "Customer Premises Equipment," or CPE) as part of the "enhanced non-voice" service.

- Resale carriers are allowed to offer terminal equipment on a competitive, non-regulated basis.

- The FCC classified terminals in two types:

  . Basic media conversion devices.

  . Equipment which does more than basic media conversion.

- Equipment which performs just basic media conversion (e.g., a modem or a non-intelligent terminal) can be offered by the common carriers as tariffed parts of "voice" or "basic non-voice" services.

- Equipment which performs more than basic media conversion (e.g., intelligent terminals) can be offered by common carriers only through separate corporate entities; if offered on a tariff basis, it must be through a resale carrier as part of an "enhanced non-voice" service. However, such equipment need not be offered under tariffs; i.e., it may be offered on an unregulated basis by anyone, including separate corporate entities of the common carriers.

- The FCC also addressed the question of the 1956 AT&T Consent Decree, under which AT&T agreed to restrict its activities to regulated communications services and markets.

  - The FCC proposed to undertake the interpretation of the Consent Decree as it applied to controversial instances.

  - In particular, the FCC proposed to determine on a case-by-case basis whether the offering of CPE or an "enhanced non-voice" service is "incidental" to the provision of a communications service and, therefore, permissible under the terms of the Consent Decree.

- Further, the FCC stated that where market forces promise to obviate the need for regulation, and where the offering by AT&T of a particular processing activity associated with an "enhanced non-voice" service or CPE, appears to be in the public interest, its intent is to allow such offerings under the Consent Decree exception provision.

- In a Further Notice of Inquiry, the FCC sought comment on still more issues that remain unresolved. In particular:

  - Whether "enhanced non-voice" should be classified as "communications" and therefore come under federal regulation, or whether "enhanced" communications and CPE should be deregulated.

  - Whether the resale principle should apply to all common carriers or just to "dominant" ones.

  - Whether the 1956 Consent Decree needs to be modified to account for technological and market changes.

  - Whether the proposed resale structure should also apply to the IRCs (International Record Carriers).

- The impact of the Tentative Decision can be summarized as follows:

  - AT&T is permitted to offer "enhanced" services via separate subsidiaries.

  - This means especially that the proposed Advanced Communications Service (ACS), which AT&T proposed in July 1978, would be permitted.

  - However, the separate subsidiaries ("arm's-length" concept) would be a stronger safeguard against cross-subsidizing competitive offerings from profits realized on regulated services than was possible under the previous rules that simply required separate accounting.

- Another area opened up to AT&T by the Tentative Decision is that of PABX - Private Automatic Branch Exchange (computerized switchboards). Here the issue is that Bell's Dimension line of PABX has some data processing capability, with industry-type applications software, such as the hotel/motel package offered by Bell companies since 1978. Again, this would have to be done via a separate corporate entity.

- The areas that were left unresolved, as outlined by the Further Notice of Inquiry, have the following significance:

  - Exactly how much separation would be required to satisfy the "separate corporate entity" requirement; the Common Carrier Bureau staff favors maximum arm's-length separation, possibly going as far as separate books, management, and directors.

  - By allowing AT&T subsidiaries to file for tariffs on "enhanced" services and CPE, the FCC opens the door for AT&T to comply with the 1956 Consent Decree while offering services and products in markets where, strictly speaking, AT&T agreed to stay out. The FCC asked for additional input on this question.

- Nearly 50 parties responded to Computer Inquiry II with comments and formal filings; they included large and small monopoly common carriers, other common carriers (OCCs), international record carriers (IRCs), banks, data processing vendors, industry associations, as well as NTIA (National Telecommunications and Information Agency, a unit of the Commerce Department), and the Justice Department.

- Although there was a general agreement on the principles embodied in the Tentative Decision (with the notable exceptions of the Justice Department and Western Union), there was also a great deal of disagreement on many of the details.

- The Justice Department and Western Union favored retaining the existing rules with some amendments.

  - The Justice Department is opposed to any regulatory action which could obviate the need to continue its current anti-trust suit against AT&T.

- Some of the areas of controversy are as follows:

  - AT&T, some data processing vendors, and industry associations want to apply the "resale structure" principle to <u>all</u> common carriers, while other monopoly carriers, some industry groups, some data processing vendors, as well as NTIA, the OCCs, and the IRCs wish to apply that principle to "dominant carriers" only; with further disagreement on the definition of "dominant."

  - Large monopoly carriers and NTIA want a flexible, non-restrictive approach to the principle of separation, so that the benefits of vertical integration would still apply; while most other respondents want a maximum "arms'-length" separation policy.

  - There was disagreement over the adequacy of the definitions of "voice," "basic non-voice," and "enhanced non-voice" services, and fears that they were either too broad (and would eventually draw all data processing under regulatory control) or too narrow and unduly restrictive in allowing offerings by common carriers.

  - Monopoly carriers and some other common carriers argued that the FCC should regulate "enhanced" services, while many other respondents argued against such regulation on the various grounds that:

    . Such "enhanced" services were not "communications."

  - Provision of such services by resale carriers is exempt from Title II of the 1934 Communications Act because such carriers are "private" rather than "common."

  - The FCC has the authority to decide not to regulate such services and it should exercise that authority as a matter of policy.

- There was also disagreement on whether the "optional-tariffing" concept is a workable solution.

- There was a general objection to the FCC's proposal to classify CPE as it related to basic media conversion on the grounds that the proposed distinguishing criterion was technically inadequate and would restrain offerings in this area.

- There was great disagreement on whether the FCC should regulate CPE. AT&T supported CPE regulation, while most other respondents urged the FCC not to regulate CPE offerings at all.

- On the question of the interpretation of the 1956 Consent Decree, AT&T was in agreement with the FCC position, while others, including the Justice Department, disagreed.

- One area in which there was substantial agreement was that of a gradual "transition period." AT&T, IBM, and CBEMA concurred on this.

- With the above as background information, the final ruling on Docket 20828 was delivered on April 7, 1980, during the final preparation of this report. INPUT's analysis of the FCC's decision is contained in Appendix D.

- Other major conflict areas related to data communications under study by the FCC include:

- The reselling or sharing of private lines. This would allow a group of users, or a reselling firm, to lease private lines from AT&T and resell chunks of the bandwidth to end users who could not justify the cost of a private line by themselves. AT&T is vehemently opposed on the grounds that such services, in effect, fall into the Message Toll Service (MTS) class - the heart of the regulated intercity and long-distance public telephone network offered by AT&T; while AT&T's competitors, especially the specialized common carriers, are enthusiastically in favor of such reselling or sharing.

- The international record (telex) traffic. The FCC issued a number of rulings that allow IRCs to extend their facilities directly into more areas in the U.S., and at the same time, allow domestic record carriers greater access to international business. The controversy is especially fueled by the technique, used by some domestic carriers, of establishing a point-to-point connection with a foreign-based carrier who then handles the international routing of messages, bypassing the U.S. facilities of the IRCs altogether.

- AT&T's rate structure for private lines, called Multi-schedule Private Line (MPL), is a subject of intense controversy. AT&T introduced MPL after the FCC rejected the Telpak rates. MPL charges for private lines are based in part on the density of traffic between the cities served: higher rates are charged on low-traffic links. AT&T's formal rationale is that this schedule reflects the true cost of providing service in the rural areas. AT&T's competitors charge that MPL is simply a scheme to allow AT&T to compete more effectively with the specialized common carriers, which concentrate their offerings between high-traffic points. The FCC agreed with this assessment and rejected MPL tariffs from AT&T a number of times. The issue is still unresolved.

D. ACTION BEFORE THE JUDICIARY

- Anti-trust proceedings by the Justice Department against AT&T date back to 1913.

- More recently, an anti-trust action brought by the Justice Department in 1949 was settled by the landmark 1956 Consent Decree, under which AT&T agreed that its operating Bell subsidiaries would restrict their offerings to regulated communications services exclusively.

- Also under provisions of the Decree, AT&T's main manufacturing arm, Western Electric, is free to manufacture and market any equipment on a competitive basis in the free market.

- In exchange, the Justice Department dropped its suit, which would have required AT&T to divest itself of Western Electric and would have broken WE into three separate companies.

- The Consent Decree is the main point of contention in numerous litigations as well as FCC regulatory proceedings.

- In 1974, the Justice Department again brought suit against AT&T. This latest anti-trust suit would require AT&T to divest itself of:

  - Western Electric.

  - The Long Lines Division.

  - All 23 operating Bell phone companies.

- The case is scheduled to come to trial in September 1980, and is likely to last a long time, since both AT&T and the Justice Department have taken intransigent positions and have given no indication of compromise.

- AT&T is vehemently opposed to giving up Western Electric, arguing that the vertical integration is essential for the provision of good service, especially as more competitors are allowed into areas in which AT&T was previously a protected monopoly.

- Another pending suit against AT&T was launched by MCI in mid-1979. MCI is a specialized common carrier competing with AT&T's Long Lines operation with a point-to-point, microwave transmission systems service called Execunet. MCI charges that AT&T and some of its subsidiary Bell operating companies conspired to restrain competition by placing various obstacles to the interconnection of MCI customers to MCI microwave facilities via the local phone hookups. The suit is similar to an earlier MCI complaint in 1974, which MCI won by a Supreme Court decision in mid-1978.

- In another action, ADAPSO (Association of Data Processing Service Organizations) petitioned the Justice Department in late 1979 to launch a suit against AT&T, charging that AT&T is selling its Bell-developed UNIX operating system for DEC computers in violation of the 1956 Consent Decree.

- A major suit by ITT was settled out of court, with AT&T agreeing to purchase as much as $2 billion worth of switch gear and other equipment from ITT over the next ten years, while ITT agreed to drop its suit, which charged that AT&T refused to purchase ITT gear in an attempt to stifle competition.

- A suit against AT&T brought by Litton Industries is pending in the federal courts. Litton charges that AT&T caused Litton Business Telephone Systems, a subsidiary, to go out of business by predatory pricing and other illegal acts. This suit is typical of nearly 40 other such suits now pending against AT&T.

- In November 1979, AT&T, Western Electric, and Southern New England Telephone Co. (AT&T Bell subsidiary) lost a $16 million anti-trust case brought by Northeastern Telephone Co., an independent telephone and PBX supplier. AT&T is appealing the case.

- Another major anti-trust action, filed against AT&T by Wyly Corp. in 1976, charging that AT&T's predatory pricing forced Datran, then a Wyly subsidiary, into bankruptcy (Datran was later purchased by Southern Pacific Communications), was settled out of court in March 1980. AT&T agreed to pay $50 million in exchange for dismissal of the anti-trust action, which sought $285 million.

VII IMPACT ON THE USER

VII IMPACT ON THE USER

A. PLANNING AND IMPLEMENTATION

- INPUT's survey of users amply confirms that on-line systems today are overwhelmingly the result of gradual, generally unplanned growth. This is evident not only from the data in Exhibit VII-1, where the results of a direct question on this subject are tabulated, but also from Exhibit VII-2, where most users cited "compatibility with existing systems" as a main reason for selecting vendors.

- Nevertheless, as Exhibit VII-3 demonstrates, users feel that "thorough planning" is one of the major factors contributing to the success of on-line systems. This interesting contradiciton is probably an indication that most users are not happy with the way their systems have grown, even though Exhibit VII-4 seems to imply that most systems have had no major problems. Some of the optimism displayed in Exhibit VII-4 is clearly due to a natural reluctance to admit to problems. The fact that most users blame the vendors (late delivery of equipment and/or software, or equipment or software not performing as promised - Exhibit VII-4) could be an indication of generally poor performance on the part of the vendors, particularly considering the high expectations that users have of promised vendor support (Exhibit VII-2).

- Advance training was cited by a significant number of users as an important contributing factor to the success of on-line systems (Exhibit VII-3). A

EXHIBIT VII-1

LENGTH OF TIME NEEDED TO PLAN AND IMPLEMENT SYSTEMS

LENGTH OF TIME	PLAN	IMPLEMENT
ONGOING PROCESS	23	1
OVER 1 YEAR	2	3
1 YEAR	-	1
9 MONTHS	2	1
6 MONTHS	3	1

NUMBER OF RESPONDENTS = 30

EXHIBIT VII-2

USERS' MAIN CRITERIA IN VENDOR SELECTION

FACTOR	NUMBER OF RESPONSES	NUMBER OF TIMES THIS FACTOR WAS RATED FIRST IN IMPORTANCE
COMPATIBILITY WITH EXISTING SYSTEMS	26	18
PROMISED SUPPORT	25	19
COST	14	10
TECHNICAL FEATURES	14	11
RELIABILITY	4	3
OTHER	2	-

NUMBER OF RESPONDENTS = 35

EXHIBIT VII-3

FACTORS CONTRIBUTING TO THE SUCCESS OF ON-LINE SYSTEMS - USERS' VIEWS

FACTOR	NUMBER OF RESPONSES	NUMBER OF TIMES THIS FACTOR WAS RATE FIRST IN IMPORTANCE
THOROUGH PLANNING	19	6
ADVANCE TRAINING	15	-
USER PARTICIPATION AND COOPERATION	13	3
ACCURATE CAPACITY PLANNING AND FORECAST OF REQUIRED RESOURCES	13	-
GRADUAL IMPLEMENTATION	11	-
USE OF OFF-THE-SHELF COMPONENTS	11	6
COST EFFECTIVENESS OF SYSTEM	10	-
HAVING GOOD PEOPLE	9	9
TEAM EFFORT	9	9
HARD WORK	9	9
VENDOR SUPPORT AND COOPERATION	4	-
TOP MANAGEMENT SUPPORT	2	-
EXPERIENCE, LEARNING FROM MISTAKES	2	-
SYSTEM PROVIDES IMMEDIATE ACCESS	2	-

NUMBER OF RESPONDENTS = 35

EXHIBIT VII-4

FACTORS CONTRIBUTING TO UNSUCCESSFUL ON-LINE SYSTEMS - USERS' VIEWS

FACTOR	NUMBER OF RESPONSES	NUMBER OF TIMES THIS FACTOR WAS RATE FIRST IN IMPORTANCE*
LATE DELIVERY OF EQUIPMENT AND/OR SOFTWARE	13	4
EQUIPMENT/SOFTWARE NOT PERFORMING AS PROMISED	13	5
INTERFACE PROBLEMS	7	3
OTHERS:		
POOR RESPONSE TIME	2	-
EQUIPMENT OR SOFTWARE UNRELIABLE	1	-
WENT ON-LINE BEFORE FULLY TESTED	1	-
FAULTY DESIGN CONCEPTS	1	-
INADEQUATE USER SPECIFICATIONS	1	-
LACK OF USERS' COOPERATION	1	-
LACK OF EXPERIENCE	1	-
LACK OF VENDOR SUPPORT	1	-
NO PLANNING	1	-
MISCELLANEOUS OTHERS	4	-

* IT SHOULD BE NOTED THAT 14 RESPONSES INDICATED THAT "NOTHING MAJOR WENT WRONG." THIS WAS GENERALLY THE FIRST RESPONSE TO THIS QUESTION, EVEN THOUGH IT WAS NOT FORMALLY RATED NUMBER 1

NUMBER OF RESPONDENTS = 35

particular consideration here is the question of trained staffs for remote DDP locations. The availability of, or willingness to establish, such staffs is critical in determining whether a DDP approach or a centralized on-line system is more appropriate. Although some manufacturers are making efforts to simplify the installation and upkeep of DDP equipment, care must be taken to establish in advance the real level of competence required to maintain the software and hardware for the selected system.

- Respondents to the survey frequently cited user participation and cooperation as a major contributing factor to successful on-line systems (Exhibit VII-3). One company with a major, highly successful, international distributed network has formalized the cooperative process by establishing "advisory councils" to arrive at a consensus for DP-related problems and to achieve user support.

- Also cited as one of the more significant contributors to successful on-line systems was accurate capacity planning and forecasting of estimated resources (Exhibit VII-3). In order to facilitate such planning it is absolutely vital to make sure that the software and hardware contain performance-monitoring features, such as CPU and I/O time, number of transactions, time of day, number and length of messages on each communication line, delay between action and response,and so forth. This data is essential, not only because it could, in itself, be used quite effectively for forecasting (one major bank interviewed relied exclusively on predictions based on current statistics), but also because such data is essential to the verification of any proposed modeling technique.

- One especially noteworthy performance-determination tool is the TPNS (Teleprocessing Network Simulator) from IBM. It is a software package that runs in its own dedicated CPU and 370X and drives or "stimulates" another 370X/CPU complex by creating data streams and events that closely approximate the desired network load. An installation having two or more IBM mainframes can use this technique to great advantage in predetermining the ability of the CPU which will act as the network host actually to perform at the required level.

The package, however, is expensive - it is licensed at about $1000/month, exclusive of hardware.

- Other IBM products related to this subject are the VM internal driver, which allows testing of a VM-based system under a load of simulated users, and the SMF/RMF facilities for performance monitoring and logging in MVS. Any operating system that will be used to support an on-line or DDP environment must have such features.

- Gradual, step-by-step implementation was also identified in Exhibit VII-3 as being important. To some extent, this represents the actual history of most on-line systems, especially IBM-based ones. Beyond the generalities, however, it is quite important to have a plan under which any proposed new on-line extensions to an existing system would be integrated with the existing base. Each step in the plan should be small enough to enable:

  - A painless retreat to the previous stage if the extension proves unworkable.

  - Thorough testing of the added feature in itself, rather than trying to determine which of a thousand new features is causing a problem.

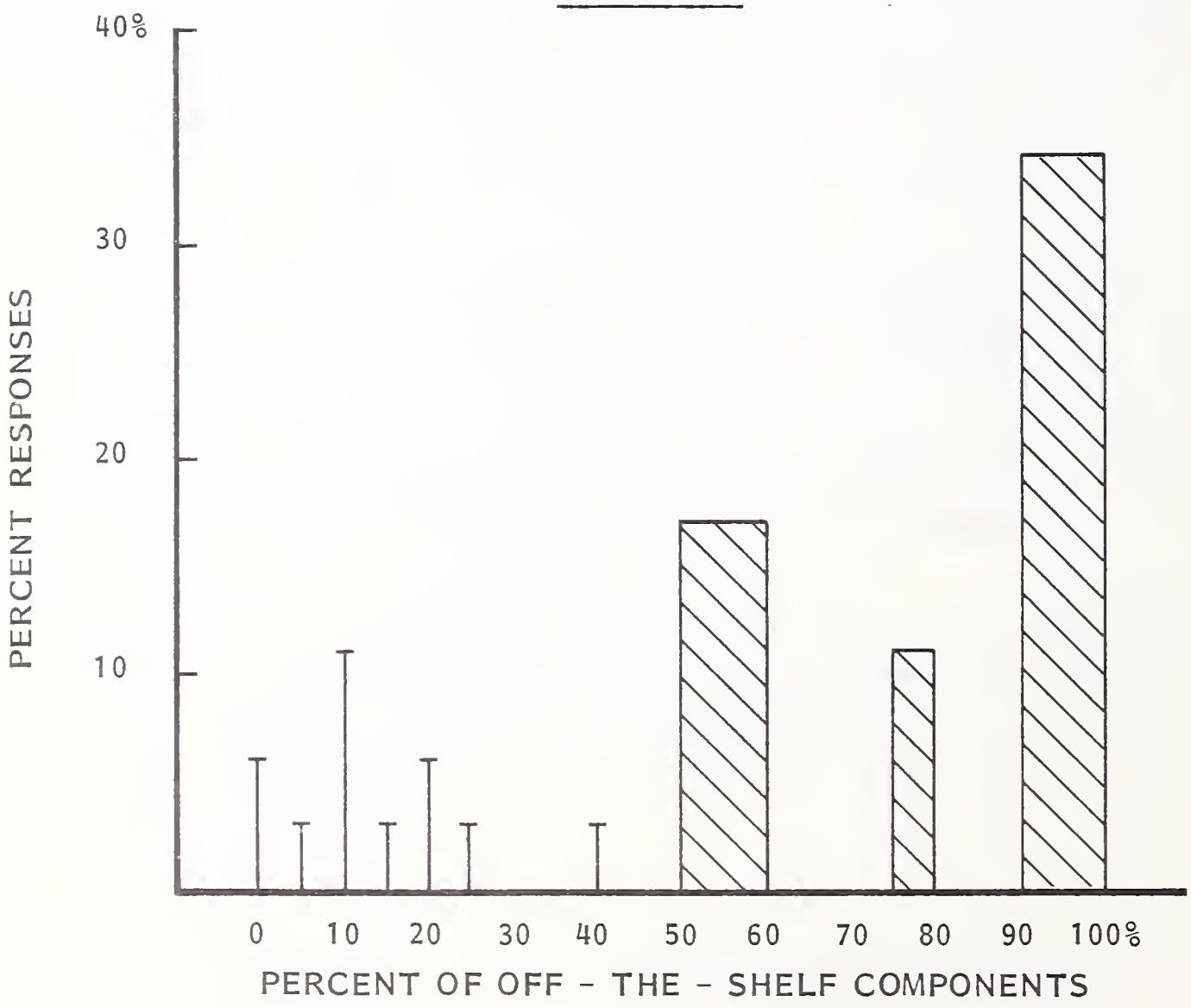
- The response to the question, "What percent of your DP hardware, DP software, and communications gear is off-the-shelf?" (Exhibit VII-3) was quite interesting. Use of off-the-shelf components was identified as a major contributing factor to successful on-line systems (Exhibit VII-3); but, as Exhibit VII-5 shows, users are far more adventuresome with the software components - many indicated that less than 50% of their software was off-the-shelf. (A word of caution here: it is quite possible that many users included their specialized applications programs as part of the on-line software when responding to this question.)

- It is interesting to note that while "having good people" was cited by only 9 of 35 users surveyed as a major factor (Exhibit VII-3), all who cited that factor

EXHIBIT VII-5

USAGE OF OFF-THE-SHELF COMPONENTS IN ON-LINE SYSTEMS

- SOFTWARE



- HARDWARE

ALL RESPONSES: 95-100% OFF-THE-SHELF

- COMMUNICATIONS GEAR

PERCENT RESPONSES	PERCENT OFF-THE-SHELF GEAR
91%	99-100%
3	90
3	70
3	NO PERCENT GIVEN

felt that it was the most important for success. This is not surprising. On-line systems are inherently complex. Even when supplied by a single vendor, the variety and complexity of hardware, software, and communications gear and their complex interaction clearly require cross-disciplinary planners and implementers. It is hard to exaggerate the importance of such experienced individuals.

- Exhibit VII-6 shows that about one-third of all users interviewed have used outside consultants in the design and/or implementation of their on-line systems, and that, in general, the consultants delivered acceptable - though by no means spectacular - performances.

- Exhibits VII-7 through VII-10 display some of the more noteworthy comments by users on subjects related to system design and implementation.

B. SECURITY ISSUES

- Exhibit VII-11 shows that about two-thirds of the users interviewed felt that security is, or will soon be, a major consideration in their on-line systems.

- On the vendors' side, there was considerably less unanimity (Exhibit VII-12), with opinions equally divided between the extreme views that "the subject is over-rated" or that "this is a major and necessary consideration."

C. DISTRIBUTED DATA BASES

- Exhibit VII-13 gives an overall summary of the differences between centralized, decentralized, and distributed data base management, and identifies the major issues in the latter type.

EXHIBIT VII-6

USERS' RATINGS OF CONSULTANTS' AND VENDORS' EXTRA SERVICES

EXTRA SERVICES	USERS' RATINGS (NUMBER OF RESPONSES)			
	IN-DISPENSABLE	GOOD OR OKAY OR "DEPENDS"	WOULDN'T USE AGAIN	DIDN'T USE OR DIDN'T ANSWER
PLANNING THE SYSTEM				
CONSULTANTS	1	8	1	25
VENDORS	2	16	2	15
IMPLEMENTING THE SYSTEM				
CONSULTANTS	1	7	1	26
VENDORS	3	16	2	14

NUMBER OF RESPONDENTS = 35

EXHIBIT VII-7

USERS' ADVICE: DESIGNING THE SYSTEM

- "In one word - PLAN!"
- "Know what you're doing; consult with people who have done it before; and don't depend on the vendor."
- "Keep it simple. If too much time is spent in planning, the system can get too complex and conflict with itself. Then the system will control you, instead of you controlling it!"
- "KISS - Keep It Simple, Stupid! Don't start vast projects and get bogged down."

EXHIBIT VII-8

USERS' ADVICE: USER AND MANAGEMENT PARTICIPATION

- "User involvement prior to implementation is very important."
- "The major thing is to get user participation."
- "Know the constituents of the user community and what they want to do. Design your plan from the president down (we did it the reverse way before)."
- "Go to a high enough level to make decisions stick. Never try to implement a system unless user is completely sold on it. Don't force it down anyone's throat - it won't work!"
- "The user should be willing to accept responsibility and control their own systems more - they should like this idea. They're so used to blaming others."

EXHIBIT VII-9

USERS' ADVICE: STAFF TRAINING

- "Make sure you have a well-trained staff group. It is the most critical thing. It's better not to rely on outside vendors."
- "Pirate some good individuals! Experience is invaluable. Someone who has actually gone through the process of implementing an on-line system, regardless of their 'textbook' knowledge."
- "Make sure you have trained personnel. We had bad luck with hardware but good luck with people."

EXHIBIT VII-10

USERS' ADVICE: CAVEATS

- "Our biggest problem was that we didn't look at our future needs enough. Our hardware and software were not capable of handling the load. If you are planning a new system now, you should also plan for 3-5 years from now."
- "Make sure equipment is tested extensively - vendors will promise the world and tell you anything."
- "Lack of pre-planning was our biggest mistake."
- "Double your estimates for the number of terminals that will have to be served."
- "Reliability is the key. To the user, it is everything. If the system doesn't run, they don't care whether it's software or hardware - all they know is that they can't use it."
- "Really evaluate ACS, X.25, and the more universal type offerings. SNA will never support these adequately."

EXHIBIT VII-11

USERS' VIEWS OF DATA SECURITY IN ON-LINE SYSTEMS

- DATA SECURITY AS A MAJOR CONSIDERATION IN ON-LINE SYSTEMS

	YES OR WILL BE	NO
NUMBER OF RESPONSES	22 (63%)	13 (37%)

- OBJECTIVES OF THE SECURITY SYSTEMS

	NUMBER OF RESPONSES (TOTAL: 28)
PROTECT DATA IN THE SYSTEM	25 (89%)
PROTECT DATA IN TRANSMISSION	8 (28%)
PROTECT PROGRAMS IN SYSTEM AND/OR TRANSMISSION	23 (82%)
PROTECT AGAINST UNAUTHORIZED OUTSIDE ACCESS	18 (64%)
NOT APPLICABLE/NO RESPONSE	7 (20%)

- HARDWARE/SOFTWARE TECHNIQUES USED TO ASSURE SECURITY

	NUMBER OF RESPONSES (TOTAL: 33)
KEYWORDS/PASSWORDS	31 (94%)
CLASS OF ACCESS	10 (30%)
DATA ENCRYPTION	5 (15%)
OTHER	5 (15%)
NOT APPLICABLE/NO RESPONSE	2 (6%)

EXHIBIT VII-12

VENDORS' VIEWS OF USERS' NEED FOR SECURITY
IN ON-LINE SYSTEMS

VENDORS	VERY IMPORTANT	VARIES	NOT IMPORTANT
MAINFRAME MANUFACTURERS	-	1	2
MINI MANUFACTURERS	2	-	1
COMMUNICATIONS HW/SW SUPPLIERS	1	-	1
COMMON CARRIERS AND VANs	2	-	1
REMOTE COMPUTING SERVICES	1	1	-
TOTAL	6	2	5

SOME SAMPLE VENDORS' COMMENTS

- "Passwords, encryption, and technology in general is not the issue; people are the real problem."
- "Subject is over-rated. Most users are not especially concerned and are well satisfied with passwords and similar operating system facilities. Encryption etc. is more of academic interest."
- "IBM is meeting the needs; the tools are here already. In the future we will see development of personal ID: voice print, finger print, etc."
- "This is a major and necessary consideration."

EXHIBIT VII-13

DBMS ON-LINE ISSUES

DEFINITIONS

Centralized - all data bases at host.

Decentralized - different bases kept at several geographically-dispersed locations, with possibly a complete set at one central location, and with possibly cross-updating on a relatively infrequent basis (e.g., once a day).

Distributed - individual elements of the data base are geographically dispersed and are accessible from any or several other geographic locations.

ISSUES	CENTRALIZED	DECENTRALIZED	DISTRIBUTED
DETERMINING THE LOCATION OF DATA REQUIRED BY EACH USER REQUEST	ALL DB ARE LOCAL - NO PROBLEM	USERS TYPICALLY QUERY LOCAL DB ONLY - NO PROBLEM	IMPORTANT AND BASIC ISSUE
RESPONSE TIME TO USER'S REQUEST	RELATIVELY MINOR ISSUE	RELATIVELY MINOR ISSUE	MAJOR ISSUE, RELATED TO COMMISSION LINK SPEED
DATA STORAGE	"DUMB" DISK	"DUMB" DISK	SMART PROCESSOR REQUIRED
SYNCHRONIZED MODIFICATION OF DUPLICATED OR MULTI-ACCESSED RECORDS	HANDLED BY SIMPLE LOCKS	HANDLED BY SIMPLE LOCKS AND INFREQUENT UPDATES	A MAJOR UNSOLVED ISSUE, SUBJECT OF RESEARCH PROJECTS

EXHIBIT VII-13 (CONT.)

DBMS ON-LINE ISSUES

SOME OBSERVATIONS
• "A programmer who doesn't know where a file is residing shouldn't have access to that file."
• "No one has a true distributed data base system today."
• "Distributed data bases are the key to the future of DDP."
• "Not knowing where the data is can lead to severe inefficiencies in execution."

- There is a wide divergence of opinions on the subject, as illustrated by the comments in Exhibit VII-13; this diversity is undoubtedly due in part to the lack of coherent definitions of the needs for and nature of distributed data base systems.

- Of the vendors interviewed, the following appear to have made some specific contributions:

  - IBM indicated that some intersystem capabilities were announced over a year ago for CICS and that such facilities are also available for IMS.

  - Network Systems Corp. proposed its HYPERchannel bus as the crucial element in implementing distributed data bases, both locally and geographically dispersed (with the Link Adapter for the latter case).

  - Datapoint's ARC appears to have implemented a version of distributed data base within a local network.

- Experimental versions of distributed data bases do exist. One well-known case is the SDD-1 system developed by Computer Corp. of America (CCA) of Cambridge, Mass.

- One user interviewed is probably typical of the current state of the art.

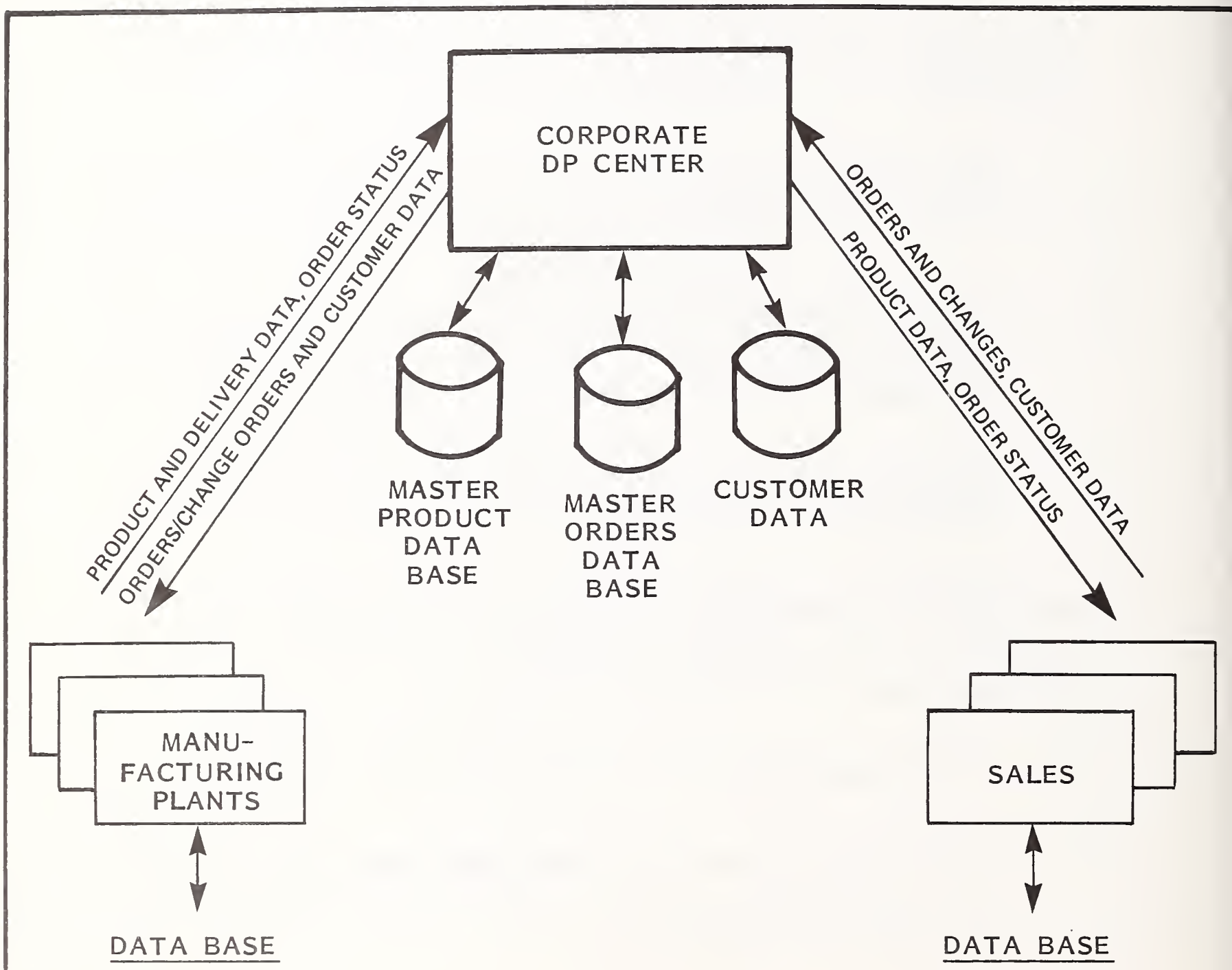
  - This user has a nationwide and international network, linking together some 40 manufacturing plants and about 70 major sales offices to a central DP center (Exhibit VII-14).

  - All communications between sales offices and manufacturing plant are via the central DP facility, where master data bases are kept on product data, orders data, and customer data.

EXHIBIT VII-14

TYPICAL "DISTRIBUTED DATA BASE,"

1980 STYLE



- OWN PRODUCTS' DATA
- ORDERS DATA FOR OWN PRODUCTS
- CUSTOMER DATA FOR OWN PRODUCTS

- COMPLETE PRODUCT DATA
- LOCAL ORDERS DATA
- LOCAL CUSTOMERS DATA

- Each sales office keeps a local data base on its own customers and the orders it originates, plus a complete duplicate of the product data base, which is essentially a computerized product catalog, updated daily.

- Each manufacturing plant keeps a data base of product data, order data, and customer data relating only to its own products.

- Sales offices transmit orders, change orders, and customer/credit data to the appropriate manufacturing plant via the central DP center.

- Plants transmit order status, delivery dates, and product data to the central DP facility, which updates its own files and transmits the data to the sales offices involved.

- All transactions are batched and are transmitted as files once daily.

- The system enforces synchronization by keeping track of chronological updates and rejecting updates that are out of sequence.

- Essential prerequisites, above and beyond the underlying network, for the success of a system like that depicted in Exhibit VII-14 are:

  - Corporate-wide standards for procedures like order numbering, customer identification, product numbering, etc.

  - Corporate-wide standards or conventions for programming practices, as well as usage of identical software packages for identical purposes at the various manufacturing plants and sales offices.

- Exhibit VII-15 reflects some of the users' feelings on data base management.

EXHIBIT VII-15

USERS' ADVICE: DATA BASE MANAGEMENT

- "Do a thorough analysis for the selection of a DBMS as well as the operating system. The 'obvious' choice did not turn out to be the right choice."

- "Make sure you have a good data base and data dictionary set up before you start anything else!"

- "If you are looking at IBM, take a good look at long-term growth: it is probably best to bite the bullet and go IMS/DC initially. This may be different in a year or two, because IBM is now pushing CICS and making it more viable for a large system now."

- "If I had to do it over, I would have brought in IMS initially. It would have saved cost and time."

- "In designing an IMS data base, get a good data base administrator - don't leave it up to analysts and programmers. Our largest problem was this type of incompatibility. You need one central person who does all the data base design."

APPENDIX A: PROFILES OF VENDORS AND USERS INTERVIEWED

EXHIBIT A-1

INTERVIEWED VENDORS' PROFILE

- COMPUTER MANUFACTURERS - MAINFRAME
  - BURROUGHS
  - CONTROL DATA CORPORATION
  - HONEYWELL INFORMATION SYSTEMS
  - IBM
- COMPUTER MANUFACTURERS - MINICOMPUTERS
  - DEC
  - HEWLETT-PACKARD
  - DATAPOINT
- COMMUNICATIONS HARDWARE/SOFTWARE SUPPLIERS
  - MEMOREX
  - NETWORK SYSTEMS CORPORATION
  - PARADYNE
- COMMON CARRIERS
  - SOUTHERN PACIFIC COMMUNICATIONS COMPANY
- VALUE ADDED NETWORKS
  - GTE/TELENET
  - TYMNET
- REMOTE COMPUTING SERVICES
  - McDONNELL AUTOMATION COMPANY
  - NATIONAL CSS

EXHIBIT A-2

INTERVIEWED USERS' PROFILE

INDUSTRY	NUMBER OF USERS INTERVIEWED		
	PHONE	ON SITE	TOTAL
BANKING	3	-	3
INSURANCE	3	-	3
LOCAL GOVERNMENT	7	-	7
UTILITIES	2	-	2
EDUCATION	5	-	5
DISCRETE MANUFACTURING	3	3	6
SERVICES	2	-	2
RETAIL/WHOLESALE	2	-	2
PROCESS MANUFACTURING	5	-	5
TOTAL	32	3	35

EXHIBIT A-3

NATURE OF EXISTING ON-LINE SYSTEMS

TOPOLOGY	NUMBER OF RESPONSES	PERCENT
HIGHLY CENTRALIZED	26	74%
DECENTRALIZED	2	6
DISTRIBUTED	3	9
COMBINATIONS	4	11
NETWORK ARCHITECTURE	**NUMBER OF RESPONSES**	**PERCENT**
COMPUTER VENDOR'S	29	83%
PACKET-SWITCHED PUBLIC	1	3
BOTH	1	3
OTHER	4	11

NUMBER OF RESPONDENTS = 35

EXHIBIT A-4

CENTRAL HOST CPU TYPE

CPU	NUMBER OF RESPONSES	PERCENT
148	1	3%
155	2	6
158	8	23
168	1	3
3031	5	14
3032	5	14
3033	11	31
AMDAHL V/5	1	3
AMDAHL V/6	1	3

NUMBER OF RESPONDENTS = 35

EXHIBIT A-5

SOFTWARE DISTRIBUTION

OPERATING SYSTEM	NUMBER OF RESPONSES	PERCENT
DOS	3	9%
DOS/VS	4	11
OS/VS1	4	11
MVT	1	3
OS (UNSPECIFIED)	1	3
SVS	4	11
MVS	20	57
OS/VS2 (UNSPECIFIED)	2	6
VM/370		
CMS	2	6
DOS/VS	1	3
OS/VS1	1	3
UNSPECIFIED	3	9
OTHER	1	3
COMMUNICATIONS ACCESS METHOD		
BTAM	8	23%
TCAM	8	23
VTAM	18	51
DATA BASE MANAGEMENT		
IMS	11	31%
CICS	11	31
DL/1	5	14
ADABAS	5	14
TOTAL	3	9
IDMS	2	6
NONE	11	31

NUMBER OF RESPONDENTS = 35

EXHIBIT A-6

PRIMARY VENDORS DISTRIBUTION

DATA PROCESSING EQUIPMENT	NUMBER OF RESPONSES	PERCENT
IBM	33	94%
CDC	3	9
STC	3	9
AMDAHL	2	6
MEMOREX	2	6
DATA GENERAL	1	3
DATAPOINT	1	3
FOUR PHASE	1	3
HARRIS	1	3
HEWLETT PACKARD	1	3
NIXDORF	1	3
TELEX	1	3
COMMUNICATIONS GEAR		
IBM	11	31%
RACAL/MILGO	10	29
CODEX	7	20
AT&T/BELL	9	26
PARADYNE	2	6
GANDALF	2	6
PRENTICE	2	6
COMTEN	1	3
OTHER	4	11
COMMUNICATIONS SERVICES		
AT&T/BELL	31	89%
ITT	1	3
W.U.	1	3
TYMNET	1	3
OTHER	2	6

APPENDIX B: DEFINITIONS

APPENDIX B: DEFINITIONS

The following definitions apply to general communications terminology which is employed in this report.

BROADBAND A general term used to describe wide bandwidth greater than a voice-grade channel (4kHz).

CIRCUIT-SWITCHED NETWORK The source and destination are connected by a dedicated communications path that is established at the beginning of the connection and broken at the end.

CONCENTRATION Concentration refers to sharing schemes in which a number of input channels dynamically share a smaller number of output channels on a demand basis. This results in a traffic smoothing which is not characteristic of multiplexing. (With resulting statistical and quering considerations.)

MULTIDROPPING A single line connects a remote station to the computer. The line may be either switched or non-switched.

MULTIPLEXING The transmission of a number of different messages simultaneously over a single circuit. This may be done by either dividing the frequency of the curcuit (frequency division multiplexing - FDM) or allocating specific slots of time to low-speed devices (time division multiplexing - TDM).

PACKET-SWITCHED NETWORK A packet-switched network maintains high average utilization of transmission facilities by: (1) combining the traffic of many users, (2) using network lines in both directions simultaneously, and (3) balancing the asymetric traffic of many users.

POINT-TO-POINT A single line connects a remote station to the computer, the line may be either switched or non-switched.

PRIVATE NETWORK A communications network operated by the customer.

PROTOCOL Protocols are required for bit synchronization so that the receiver knows when a bit starts and ends so that it can be sampled; for character synchronization so that the receiver can determine which bits belong to a character; and message synchronization so that the receiver can recognize the special character sequences which delineate messages.

PUBLIC NETWORK Any network which provides service to many customers.

VALUE ADDED NETWORK A value added network (VAN) typically uses common carrier network transmission facilities and augments these facilities with computerized switching. These networks have become associated with packet-switching technology because the public VANs which have received the most attention (Telenet and TYMNET) employ packet-switching techniques. However, other added data service features such as store-and-forward message switching, terminal interfacting, error detection and correction, and host computer interfacing are of equal importance.

WIDEBAND CHANNEL (COMMON CARRIER) Common carrier facilities provided for transferring data at speeds of from 19,200 baud up to the one million baud region. (Greater than a voice channel.)

APPENDIX C: QUESTIONNAIRES

USER QUESTIONNAIRE

COMMUNICATIONS ASPECTS

1. What is the estimated percent of the total data processing workload being handled as:

	Now	1981	1982-5
a. Batch:			
Local	____	____	____
Remote Job Entry	____	____	____
Job Networking (NJE/NJI)	____	____	____
b. On-Line In-House:			
Interactive Program Development	____	____	____
On-Line Transaction/Inquiry:	____	____	____
Locally Attached GP Terminals	____	____	____
Remote GP Terminals	____	____	____
Locally Attached Industry Terminals	____	____	____
Remote Industry Terminals	____	____	____
c. Outside Remote Computer Services:			
Batch	____	____	____
On-Line	____	____	____

2. What is the estimated percent of total on-line data message traffic over the following facilities:

	Now	1981	1982-5
a. Private Leased/Owned Lines:			
Point-to-Point, Voice and Below	____	____	____
Point-to-Point, Wideband	____	____	____
Point-to-Point, DDS/Digital	____	____	____
Multidropped	____	____	____
Multiplexed/Concentrated	____	____	____
Other	____	____	____
b. Switched (Common Carrier) Lines:			
Voice and Below	____	____	____
DSDS	____	____	____
c. Packet Switched Public Data Network:			
d. Other (specify) _____	____	____	____

3. Estimate what percent of total communications budget is for:

	Now	1981	1982-5
Data Transmission (CPU/CPU or CPU/Terminal)	____	____	____
Voice	____	____	____
Telex/TWX	____	____	____
Facsimile	____	____	____
Other	____	____	____

4. Have you evaluated the new proposed communications services?

	Evaluated	Plan to Use	Comments
SBS	☐	☐	_____
ACS	☐	☐	_____
XTEN	☐	☐	_____

SYSTEM CONFIGURATION

1. Characterize the system structure by percentage:

	System No. 1	2	3
Highly centralized (one or few hosts at one location)	____	____	____
Decentralized (hosts at several locations, not interconnected or loosely connected)	____	____	____
Distributed (hosts and remote CPUs geographically dispersed but heavily interconnected)	____	____	____

2. The system(s) rely primarily on: (give percent)

	1	2	3
Computer manufacturer's net architecture (SNA, DECNET, etc.) Which?	____	____	____
Packet switched public network/X.25. Which net?	____	____	____
Other (specify) _____	____	____	____

3. What percentage of the system(s) is built with off-the-shelf components?

	1	2	3
Standard Products:			
Hardware	____	____	____
Software	____	____	____
Communication Gear	____	____	____

4. Describe the structure of the system(s):

	1	2	3
Host CPU Model(s), Memory Size(s)			
Host Software:			
Operating System			
Application Programs			
Communications Access Method			
Communications Processor or FEP			
Number of Communication Lines Supported			
Below 2400 Baud			
2400 - 9600 Baud			
19.2K Baud			
Over 19.2K Baud			
Remote CPUs Type(s)			
Number and Type of Remote Terminals			

5. Would you characterize your DDP network(s) as:

	1	2	3
Tree Structured			
Ring Structured			
Hierarchical			
Complex (mixture of above)			

6. Do you think it is important for DDP nodes to be architecturally compatible with the hosts? (For example, would you prefer to have IBM 4300 Series equipment rather than IBM 8100s or other non-compatible systems)

☐ Yes ☐ No

Why?

PLANNING AND IMPLEMENTATION

1. The primary responsibility for the design of the on-line systems is in:

	1	2	3
Corporate DP Organization	____	____	____
Corporate Planning Function	____	____	____
Joint Effort Among Several Corporate Functions	____	____	____
Other Corporate Function (specify)			
_____	____	____	____

2. How successful were the plans and implementation of the on-line system?

	1	2	3
Very successful - the system was implemented pretty much as planned, and the resulting system is considered a success by both users and management	____	____	____
Moderately successful - some aspects of the system did not get implemented as planned or when planned or encountered substantial difficulties; or else users and/or management are not completely happy with the results	____	____	____
Dubious success - results were disappointing	____	____	____

3. List in order of importance the factors that contributed to the success of on-line systems:

_____ Thorough planning

_____ Gradual implementation

_____ Use of off-shelf components

_____ User participation and cooperation

_____ Advance training, staff and users

_____ Accurate estimate of required resources

_____ Accurate capacity planning

_____ Cost/effectiveness

_____ Other (explain) _____

4. List in order of importance the factors that contributed to unsuccessful or problematical on-line systems:

_____ Late delivery of equipment/software/communication facilities

_____ Equipment or software not performing functions as promised

_____ Equipment or software unreliable and recovery facilities inadequate

_____ Network control and management poor and out of hand

_____ Poor response time and/or low transactions/minute throughput

_____ Interface problems between various vendors' equipment/ software

_____ System went on-line before fully tested

_____ Design concepts proved faulty and inadequate

_____ Other (specify) _____

5. If you used outside resources in planning or implementation, rate their contributions:

	Planning			Implementation		
	Indispensible	Good	Wouldn't Use Again	Indispensible	Good	Wouldn't Use Again
Consultants	_____	_____	_____	_____	_____	_____
Vendors	_____	_____	_____	_____	_____	_____
Other	_____	_____	_____	_____	_____	_____

6. About how long did it take to:

	1	2	3
Plan the System	_____	_____	_____
Implement the Plan	_____	_____	_____

7. Who were the primary vendors selected to supply the major portions of the system(s):

	1	2	3
Computer/Data Processing Equipment	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
Communications Gear (modems, muxes, concentrators)	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
Communications (transmission) Services	_____	_____	_____
	_____	_____	_____
	_____	_____	_____

8. What were the main criteria for vendor selection?

_____ Cost

_____ Promised Delivery

_____ Promised Support

_____ Technical Features

_____ Compatibility with Existing Systems

_____ Other (explain)

_____

_____

_____

SECURITY

1. Is data or access security a major consideration in your on-line systems?

_____

_____

_____

2. What are the objectives of the security system:

_____ Prevent unauthorized in-house access to data in system

_____ Prevent unauthorized in-house access to data in transmission

_____ Prevent unauthorized in-house access to programs in system or transmission

_____ Prevent unauthorized outside access to system

3. What hardware/software techniques are in use to assure security?

_____ Data Encryption

_____ Keywords (or codes)

_____ Class-of-Access (such as personnel or payroll records)

_____ Other (explain)

_____

_____

_____

REGULATION AND STANDARDS

1. How would you characterize the impact of government regulations in the communications/common carrier area on your on-line systems?

_____ Great impact (describe)

_____

_____

_____

_____

_____ No impact that we can tell

2. Is there anything you think needs to be done in the area of government regulations of the communications/common carriers?

_____

_____

_____

_____

3. Which specific national and international standards have had an impact on your on-line systems?

_____

_____

_____

_____

4. How are these standards for meeting your on-line needs?

_____ Excellent

_____ Adequate

_____ Poor

5. What changes (additions/deletions) would you like to see in these standards?

6. Computer vendors such as IBM and DEC have developed network architectures (SNA, Decnet) that are incompatible in part with the network architecture defined by ISO and exemplified by X.25. Do you have an opinion on:

   Which architecture is likely to become more prevalent?

   Which architecture is better for your needs? Why?

7. Have you done anything to minimize possible adverse impact of network architecture competition and the effect of government regulation on your on-line system(s)?

8. Are you familiar with the current controversy in the FCC concerning the sale of the spectrum?

☐ Yes ☐ No

If yes, what do you think of the issue?

_____

_____

_____

_____

_____

_____

DBMS AND DDP

1. How did data base or DBMS considerations affect design and implementation of your on-line system(s)?

_____

_____

_____

_____

2. How would you describe the nature of the data base in your on-line system:

	1	2	3
Centralized at one host	_____	_____	_____
Partitioned among hosts and remote nodes	_____	_____	_____
Duplicated at hosts and remote nodes			
Other (describe)			
_____	_____	_____	_____

3. What software package(s) are responsible for managing the data base in your on-line systems?

_____

_____

_____

_____

4. Are there any major conceptual problems associated with your on-line data base(s)?

5. Do you know of, or are you considering solutions to this problem? (describe)

6. What advice would you give anyone who is planning to implement an on-line system?

CATALOG NO. UDOL[ ][ ][ ]

VENDOR QUESTIONNAIRE

GENERAL

1. If an end user came to you for advice on implementing an on-line network, what would be your recommendations on:

   a. Currently available services and technology

   _____

   _____

   _____

   b. Implementation strategy

   _____

   _____

   _____

   c. Things to watch out for (avoid)

   _____

   _____

   _____

   d. Future trends worth watching

   _____

   _____

   _____

2. The products/services offered by your firm are of value to end users implementing on-line systems in the following areas: (check all that apply)

_____ Common Carrier Service

_____ Value Added Network (if so, please define "value added")

_____

_____

_____ Remote Computing Service

_____ Remote Batch, Job Networking

_____ Distributed Data Processing (define your view)

_____

_____

_____ On-Line Inquiry/Response

Data Entry/Collection

_____ Network Control, Diagnostics, Error Recovery

_____ Capacity Planning

_____ Terminal Hardware (intelligent/dumb)

_____ Communications Hardware (FEP, modem)

_____ Security

_____ Communication Services Other Than Data (images/fax, voice, teleconferencing, etc.)

_____ Automated Office

_____ Word Processing

_____ Other (describe)

_____

_____

3. What specific advantages does your product/service offer?

_____

_____

_____

_____

4. How do you quantify these advantages for user?

_____

_____

_____

_____

1. What impact on on-line systems do you see due to developments in data base management systems and distributed data processing?

2. In your view, what are the security issues in on-line systems? Does current technology address these satisfactorily? If not, what in your view needs to be done or is likely to be done? Are users sensitive to security issues?

3. In your view, what are the pros and cons of relying on a single vendor (or a few vendors) as opposed to multi-vendors in building on-line systems?

REGULATION

1. In your view/experience, the current trend in government regulation relating to communications is:

   _____ Towards More Strict Regulation

   _____ Towards Less Regulation

   _____ No Real Change in Direction

2. From your point of view, is this good or bad? (explain)

3. From the point of view of the end user, is this good or bad? (explain)

4. What would you like to see done (or undone) in the area of government regulation?

5. Are you familiar with current discussions in the FCC concerning the sale of spectrum?

Yes No

If yes, what is your opinion of the proposal?

6. What is your general reaction to current congressional and regulatory activity?

STANDARDS

1. In your view/experience, what national/international standards are critical for the user to understand in implementing on-line systems? (separate who sets those standards)

2. For meeting current and foreseeable future on-line needs, the quality of these standards is:

   _____ Excellent

   _____ Adequate

   _____ Poor

3. What changes/additions/deletions do you think should be made to these standards and/or the way they are set?

INP

COMPETITION/CONFLICTS

1. A number of computer vendors have invested great resources in developing network architecture, and so have communications-oriented bodies; the architectures so developed are in many ways incompatible. Who do you see eventually winning this conflict - ISO/X.25 type networks or SNA/DECNET type?

2. Merging data processing and communications technologies are raising basic questions about competition versus regulation. What is your organization's posture on this question?

3. What, if anything, can the user do to minimize the impact of the issues in Questions 1 and 2 above on his organization's on-line system plans?

APPENDIX D: PRELIMINARY ANALYSIS OF THE FCC's FINAL DECISION IN THE SECOND COMPUTER INQUIRY

APPENDIX D: PRELIMINARY ANALYSIS OF THE FCC's FINAL DECISION IN THE SECOND COMPUTER INQUIRY

A. INTRODUCTION

- Against the background of regulatory issues and conflicts contained in Section VI of this report, the FCC reached a landmark deregulatory decision. While the full text of the FCC's order of April 7, 1980, was not immediately available, it is apparent that observers sensitive to the deregulatory orientation of the present commission were surprised by the scope of the decision. How effective the order will be in solving the many problems associated with establishing a meaningful national computer/communications policy is questionable; but one thing is certain, the reverberations will last for years.

B. ISSUES AND ANSWERS

- This decision attempts to resolve two fundamental issues which have plagued the FCC for many years:

  - The deregulation of customer premises equipment (CPE). (As pointed out in the body of this report, the FCC has traditionally tended to distinguish between voice and data terminals in its past deliberation.)

- The possible regulation or deregulation of data communications and/or data processing services. (This was previously approached through a complex exercise in semantics which assumed that communications services would be regulated and data processing services would not; the result was a broad, grey area called "hybrid services.")

- The issue of CPE has been clearly addressed by the FCC decision: both voice and data terminals will be deregulated effective March 1, 1982.

- The services provided by common carriers have been defined as either "basic services" or "enhanced services."

  - Basic services provide for transmission of information.

  - Enhanced services add data processing services that change (or enhance) the transmitted information.

  - Only basic services will remain regulated.

- Common carriers other than AT&T and GTE are not required to maintain maximum separation of regulated communications services from unregulated data processing services.

- Carriers under the direct or common control of AT&T and GTE will be treated in the following manner:

  - They may not market, install, service, or maintain CPE except through a separate subsidiary. The separate subsidiary, in turn, may not provide transmission equipment. (This rule may be relaxed in sparsely populated areas.)

  - They may not provide enhanced services except through a separate subsidiary. (CPE may be provided in conjunction with the enhanced services provided through this subsidiary.)

- Last, but not least, AT&T is not prohibited from providing enhanced services for CPE under the terms of the 1956 Consent Decree.

C. PRELIMINARY ANALYSIS OF THE FCC DECISION

- The FCC has been in a technical, economic, and political maelstrom for over ten years. The order issued on April 7, 1980, appears to be an effort to extricate itself by forcing action from other interested parties. It is probable that the FCC will fail in its primary objective, but be successful in involving everyone.

- AT&T and other telephone companies will now be forced to compete in the open market for both business and residential telephone and terminal equipment.

  - It will no longer be possible to bundle such equipment with transmission service.

  - This creates a truly competitive situation and should lower the costs of CPE. Current telephone interconnect equipment vendors may face reduced profit margins once AT&T starts to compete.

  - The removal of CPE from the common carriers' cost base will have an unpredictable impact on the rates for basic services. (A Federal-State Joint Board will be convened to determine if other cost allocations should be adjusted.)

  - AT&T has significant advantages in terms of a manufacturing economy of scale, but it does not welcome the marketing challenge of potential competitors, especially IBM.

- The provision deregulating enhanced services will provide opportunities for many computer services companies to sell basic communications services. While this has been happening on a sub rosa basis for many years, it will permit much greater flexibility in the offerings of such companies. (The Tymshare/Tymnet relationship would no longer be required. In addition, this flexibility could encourage IBM to re-enter the computer services market.)

- AT&T would be permitted to enter the enhanced services area through a wholly-owned subsidiary. If INPUT's analysis is correct, this has the following ramifications:

  - The subsidiary could sell value added communications services in competition with the fledgling VANs.

  - The subsidiary could also sell CPE and include a wide variety of "intelligent terminal equipment" that will become increasingly difficult to distinguish from minicomputers (or even mainframes).

  - In addition, both software and processing services could be provided by the subsidiary's network. AT&T would be involved effectively in all aspects of the data processing market.

- There are opportunities for all to compete in a rapidly expanding and dynamic marketplace. However, everyone will also have reason to be apprehensive about the competitive environment which has been created.

  - The Bell System's monopoly could be seriously threatened by both CPE deregulation and potential offerings of enhanced services vendors.

  - IBM could be confronted with a new contender in the data processing arena; one with more resources than all of the current competitors combined.

  - Everyone else could be exposed to the possibility of being trampled inadvertently as the two superpowers vie for new market positions.

D. NOW WHAT?

- The only thing really certain, on the basis of this latest FCC order, is that the decision will prompt extensive litigation over an extended period of time. Indeed, there are so many potential challenges that it is impossible to predict exactly when any practical results will be discernible. Among the possible litigants are:

  - Any company offering communciations or data processing services and equipment.

  - Industry associations including the Computer and Communications Industry Association (CCIA), and independent and interconnect telephone associations.

  - State Public Service Commissions on whom the CPE deregulation has severe impact.

  - The Justice Department which prefers that its antitrust suits against AT&T not be disrupted by the FCC.

- Congress has expressed some sentiments on abolishing the FCC when (if ever) the Communications Act of 1934 is rewritten. This attitude exists among both those who oppose regulation and those who oppose deregulation. (If all major decisions must be determined by the courts, this could add fuel to that fire.)

- It does not appear that the establishment of a national communications policy is any closer to resolution, quite the contrary. This should be a matter of grave concern to all citizens, especially those responsible for the planning and implementation of advanced computer/communications networks.